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Status Report on the Development of the NAPAP (National Acid Precipitation Assessment Program) Emission Inventory for the 1980 Base Year and Summary of Preliminary Data

Engineering-Science, Fairfax, VA

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STATUS REPORT ON THE DEVELOPMENT OF THE NAPAP EMISSION INVENTORY FOR THE 1980 BASE YEAR AND SUMMARY OF PRELIMINARY DATA

by

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16. ABSTRACT The report documents the compilation of a 1980 emissions inventory for use in the National Acid Precipitation Assessment Program (NAPAP). The current inventory (Version 3.0) contains point source data for over 50,000 plants (with over 201,000 emission points) and area source data for the 3,069 counties in the 48 contiguous states and the District of Columbia. Emissions of SO2, NOx, VOC, CO, and particulates are included in the inventory, but the report focuses on SO2, NOx, and VOC which are of primary interest for acid deposition research. NAPAP Version 3.0 emissions of SO2, NOx, and VOC are 27.1, 23.7, and 23.3 million tons per year, respectively. Summaries of emissions by source category, geographic region, state, fuel type, season, and stack height range are given, along with emission density maps and fuel use summaries. Emissions in the NAPAP data base are in reasonable agreement with Work Group 3B and EPA/OAQPS emissions trends estimates. NAPAP fuel use data show reasonable agreement with fuel values in DoE's State Energy Data Report. Version 3.0 of NAPAP represents a detailed inventory of emissions on a national scale; however, it should be noted that additional improvements are planned.

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NOTICE

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

This report describes the current status of the development of a 1980 emissions inventory for use in the National Acid Precipitation Assessment Program (NAPAP) and presents summaries of the information collected to date. It is being distributed at this time primarily for review purposes. While it describes the methods used to compile the 1980 NAPAP emissions inventory and gives preliminary results from applying those methods, improvements to the methods and data used are currently in process. Other changes can be anticipated as the review process identifies the need or opportunity for changes. Thus, it is important to emphasize the interim nature of this report and the many numbers it contains. The report is being given circulation at this time to facilitate the review and critique process, not because it is a completed document suitable for uncritical use. Any use outside of these bounds should be considered with the utmost caution.

This project was administered by the U.S. Environmental Protection Agency (EPA) with funding from NAPAP's Task Group B - Man-Made Sources. The project has been a cooperative effort involving personnel from both the EPA Office of Research and Development (ORD) and the EPA Office of Air Quality Planning and Standards (OAQPS). ORD has the lead responsibility with EPA for acid precipitation research and represents EPA on Task Group B. OAQPS maintains the emission inventory data base used as a primary source of data for NAPAP and is responsible for developing agency guidance on procedures for emission inventory data collection. The report has been reviewed and approved for publication consistent with the above conditions by appropriate EPA and NAPAP personnel. Comments should be directed to the EPA Project Officers, David Mobley, at 919/541-2612, and Chuck Mann, at 919/541-5694.

David J. Beecy

David J. Beecy, Chairman
NAPAP Task Group B - Man-Made Sources
U.S. Department of Energy

ABSTRACT

This report documents the to-date compilation of a 1980 emissions inventory for use in the National Acid Precipitation Assessment Program (NAPAP). Further improvements will be made to the inventory; the data in this report are preliminary. The current inventory (Version 3.0) contains point source data for over 50,000 plants with over 201,000 emission points and area source data for the 3,069 counties in the 48 contiguous states and the District of Columbia. Emissions of SO_2, NO_x, VOC, CO and particulates are included in the inventory but the report focuses on SO_2, NO_x, and VOC which are of primary interest for acid deposition research. NAPAP Version 3.0 emissions of SO_2, NO_x, and VOC are 27.1, 23.7, and 23.3 million tons per year, respectively. Summaries of emissions by source category, geographic region, state, highest emitting plants, fuel type, season, and stack height range are presented along with emission density maps and fuel use summaries. Emissions in the NAPAP data base are in reasonable agreement with Work Group 3B and Office of Air Quality Planning and Standards (OAQPS) emissions trends estimates. NAPAP fuel use data show reasonable agreement with fuel values in DOE's State Energy Data Report.

Version 3.0 of NAPAP represents a detailed inventory of emissions on a national scale. Additional improvements are planned, focusing on major point sources. The bulk of future NAPAP resources will be used to meet the needs of Eulerian modeling activities. New pollutants such as sulfates and ammonia are required as well as speciation of VOC and NO_x. Hourly temporal resolution of emissions and spatial resolution of emissions into small grid zones covering the contiguous U.S. are also needed for modeling.

This report was submitted in fulfillment of Work Assignment Nos. 40, 57, and 58 of Contract No. 68-02-3509 by Engineering-Science (ES), Fairfax, Virginia, under the sponsorship of the U.S. Environmental Protection Agency (EPA). This report covers the period from January 1983 to May 1984.

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EXECUTIVE SUMMARY

A detailed 1980 base year emission inventory has been developed by Task Group B of the Interagency Task Force on Acid Precipitation to support the needs of the National Acid Precipitation Assessment Program (NAPAP). This report contains summary data from the current version (3.0) of the NAPAP inventory.

DEVELOPMENT HISTORY OF VERSION 3.0

The NAPAP data were developed starting with information from the U.S. Environmental Protection Agency's (EPA's) National Emissions Data System (NEDS). These data have been improved by incorporating the latest available emission factors, substitution of data from the Northeast Corridor Regional Modeling Project and other more representative of 1980 NEDS data, cross-checking the electric utility data with the U.S. Department of Energy (DOE) data compiled by E.H. Pechan and Associates, crosschecking data with information from the U.S.-Canada Work Group 3B report, and adding county centroid latitude and longitude for sources with missing or incorrect Universal Transverse Mercator (UTM) coordinates. The NAPAP data are stored in the Emission Inventory System (EIS) format on the EPA IBM computer at Research Triangle Park, North Carolina. The data consist of point source data for 50,200 establishments with over 201,000 emission points and area source data for each of 3,069 counties included in the 48 contiguous states of the U.S. and the District of Columbia. Currently, NAPAP reports emissions of SO_2, NO_x, VOC, particulates, and CO. It is planned to add sulfates, ammonia, and other pollutants in the future. This report focuses on emissions of SO_2, NO_x, and VOC which are of primary interest for acid deposition research purposes.

EMISSIONS SUMMARY AND COMPARISON

The following tables summarize national emissions of SO_2, NO_x, and VOC from Version 3.0 of NAPAP. Regional totals of emissions and state totals of point and area source emissions are also shown. More detailed emissions summary information is presented in Chapter 2, including emissions by state, the largest emitting plants, emissions by season and stack height ranges, and emission density maps.

NAPAP Emissions by Source Category (Preliminary Data)
(10^6 tons/year)

	SO_2	NO_x	VOC
Electric Utilities	17.3	8.1	0.1
Industrial Combustion	3.7	4.5	1.0
Residential/Commercial Combustion	0.9	0.7	0.1
Non-ferrous Smelters	1.2	Neg	Neg
Other Industrial Processes	3.0	1.0	4.5
Transportation	0.9	9.1	8.0
Miscellaneous	0.1	0.3	9.6
Total	27.1	23.7	23.3

NAPAP Emissions by Region[a] (Preliminary Data)
(10^6 tons/year)

	SO_2	NO_x	VOC
EPA Region I	0.7	0.6	1.2
EPA Region II	1.2	1.2	1.8
EPA Region III	3.8	2.3	2.1
EPA Region IV	6.5	4.1	4.0
EPA Region V	7.9	4.8	4.5
EPA Region VI	2.3	5.3	4.0
EPA Region VII	2.0	1.8	1.4
EPA Region VIII	0.8	1.2	0.9
EPA Region IX	1.5	1.7	2.4
EPA Region X	0.4	0.7	1.0
31 Eastern States[b]	22.3	15.1	15.3
Nation[a]	27.1	23.7	23.3

[a] Includes Continental U.S. only.
[b] Includes tier of states from Minnesota south to Louisiana and all states east.

National Summary of NAPAP Emissions by State (Preliminary Data)
(10^3 tons/year)

State	SO_2			NO_x			VOC		
	Point	Area	Total	Point	Area	Total	Point	Area	Total
AL	774	76	850	273	252	525	73	351	424
AZ	824	20	844	141	153	294	13	228	241
AR	59	30	89	65	167	232	14	230	244
CA	416	118	534	455	868	1,323	417	1,691	2,108
CO	114	20	134	137	155	292	21	300	321
CT	51	18	69	41	103	144	44	259	303
DE	105	22	127	36	33	69	26	48	74
DC	11	6	17	5	22	27	1	43	44
FL	1,124	78	1,202	246	383	629	23	725	748
GA	847	30	877	279	308	587	28	495	523
ID	36	20	56	9	82	91	6	205	211
IL	1,360	99	1,459	655	462	1,117	208	768	976
IN	1,746	134	1,880	536	324	860	117	472	589
IA	366	24	390	167	182	349	31	241	272
KS	198	33	231	302	290	592	81	241	322
KY	1,113	45	1,158	373	231	604	125	280	405
LA	343	158	501	568	253	821	322	299	621
ME	122	12	134	21	43	64	20	73	93
MD	273	23	296	114	164	278	76	270	346
MA	317	45	362	88	184	272	108	444	552
MI	844	34	878	378	368	746	238	730	968
MN	242	21	263	229	227	456	63	360	423
MS	256	50	306	99	196	295	52	234	286
MO	1,236	61	1,297	349	258	607	177	429	606
MT	146	22	168	28	102	130	12	203	215
NE	65	12	77	92	118	210	46	119	165
NV	140	7	147	76	47	123	4	73	77
NH	102	5	107	30	30	60	20	69	89
NJ	234	69	303	160	274	434	155	562	717
NM	247	11	258	224	83	307	52	109	161
NY	787	77	864	321	427	748	143	988	1,131
NC	621	32	653	302	268	570	108	465	573
ND	95	19	114	103	65	168	2	46	48
OH	2,655	50	2,705	665	554	1,219	165	914	1,079
OK	86	16	102	177	285	462	72	297	369
OR	31	25	56	53	175	228	40	279	319
PA	1,770	82	1,852	595	487	1,082	240	802	1,042
RI	10	4	14	6	30	36	13	84	97
SC	324	18	342	154	148	302	228	259	487
SD	34	7	41	22	55	77	3	88	91
TN	1,103	31	1,134	336	237	573	157	353	510
TX	1,081	260	1,341	1,543	1,943	3,486	940	1,710	2,650
UT	89	27	116	80	95	175	11	134	145
VT	3	7	10	1	43	44	4	36	40
VA	338	48	386	160	251	411	105	358	463
WA	280	46	326	131	219	350	48	373	421
WV	1,091	13	1,104	352	121	473	14	124	138
WI	668	20	688	205	221	426	76	372	448
WY	224	25	249	184	115	299	20	74	94
Totals	25,001	2,110	27,111	11,566	12,101	23,667	4,962	18,307	23,269

NAPAP Emissions by Season (Preliminary Data)
(percent of total)

	SO_2	NO_x	VOC
Winter	27	26	24
Spring	24	24	25
Summer	25	25	26
Fall	24	25	25
Total (10^6 tons/year)	27.1	23.7	23.3

NAPAP Emissions by Stack Height Range (Preliminary Data)
(percent of total)

Range (ft)	SO_2	NO_x	VOC
0-120	20	34	94
121-240	15	17	5
241-480	22	20	1
>480	43	29	0
Total (10^6 tons/year)	25.0	11.6	5.0

NAPAP County Emission Density Summary (Preliminary Data)

Density Range (tons/mi^2)	SO_2		NO_x		VOC	
	Counties in Range (%)	Emissions in Range (%)	Counties in Range (%)	Emissions in Range (%)	Counties in Range (%)	Emissions in Range (%)
0-10	84	10	78	24	78	27
10-30	6	11	12	19	14	20
30-100	6	25	7	30	6	24
100-1000	4	51	3	27	2	27
>1000	0	3	0	0	0	2

Comparison of NAPAP, Trends, and Work Group 3B Emissions of SO_2 and NO_x (Preliminary Data)
(10^6 tons/year)

	SO_2			NO_x		
	WG3B	Trends	NAPAP	WG3B	Trends	NAPAP
Electric Utilities	17.3	17.1	17.3	6.2	7.1	8.1
Non-Utility Combustion	3.5	3.6	4.6	4.6	4.1	5.2
Non-Ferrous Smelters	1.3	1.3	1.2	0.0	0.0	0.0
Transportation	0.9	1.0	0.9	9.3	10.5	9.1
Other Sources	3.3	2.7	3.1	1.1	1.1	1.3
Total	26.3	25.7	27.1	21.2	22.8	23.7

The SO_2 emissions are dominated by electric utilities, primarily from coal-fired generating stations located in the eastern U.S. Other significant source sectors include industrial combustion (again, mostly from coal), non-ferrous smelters (primarily copper smelters in the southwestern U.S.), and other industrial processes (largely petroleum refining, chemicals, cement plants, and pulp mills). For NO_x, the largest sources are transportation (mostly highway vehicles), electric utilities, and industrial combustion. Electric utility emissions result primarily from coal combustion, but a significant portion also results from natural gas combustion. For industrial sources, the largest portion of NO_x emissions comes from natural gas combustion. For VOC, emissions result largely from transportation (again primarily highway vehicles), other industrial processes and miscellaneous sources. Principal industrial process sectors include chemicals, petroleum refining, petroleum transportation and storage, and a wide variety of activities involving organic solvent consumption. Miscellaneous sources include additional organic solvent use not accounted for by point sources in NAPAP, retail gasoline service stations, and forest wildfires.

The geographic breakdown of SO_2 emissions shows that EPA Regions IV and V are the largest contributors, accounting for about 53% of the national total. Region III also has significant emissions with a 14% contribution. The eastern 31 states account for over 82% of nationwide emissions. For NO_x, Regions IV, V, and VI are the highest emitters with 60% of the national total. Region III is again next with 10% of total emissions. Although not as great a contribution as for SO_2, the eastern 31 states still account for about 64% of national emissions. Regions IV, V, and VI are also responsible for the greatest amount of VOC emissions with 54% of the national total. The eastern 31 states account for 66% of the nation's emissions which is about the same as for NO_x. Thus, emissions of all three pollutants are concentrated in the east, especially those of SO_2. Substantial variability in SO_2 emissions exists between regions with less difference for NO_x and even less for VOC.

The relative importance of point versus area source emissions varies for each of the three pollutants. Point sources contribute about 92% of national SO_2 emissions. For NO_x, emissions are nearly evenly distributed with area sources contributing 51%. Area sources, on the other hand, emit about 79% of total VOC emissions. Ohio, Pennsylvania, and Indiana have the greatest SO_2 emissions. Texas, California, and Ohio are the greatest NO_x emitters while Texas and California have the greatest VOC emissions. The relative contribution of point versus area sources varies from state to state.

Seasonal variations were dervied from operating data in the point source inventory and seasonal factors added to the area source file. Power plant operating data were updated based on monthly fuel use data reported on FPC Form 4. Seasonal variations are less than expected. For SO_2, the maximum variation is three percentage points from 24 to 27%. Emissions are greatest in winter and lowest in spring and differ by 11.9%. The maximum variation for NO_x is only two percentage points - 24 to 26%. Emissions are again greatest in winter and lowest in spring with only a 6.3% difference. The maximum variation for VOC is the same as for NO_x, 24 to 26%, with an 8.0% difference between the highest season, summer, and the lowest season, winter.

Although is it effective plume height that is of greatest interest to modelers, only stack height data are included in NAPAP. Thus, only emissions by stack height range could be summarized for this report. The stack height ranges were not selected based on any specific criteria but nevertheless show how emissions vary with height. Emissions of SO_2 in the three lowest ranges are similar but emissions from stacks >480 feet in height are about twice as much as from any other one range. This demonstrates the dominance of power plants and smelters with respect to SO_2 emissions. NO_x emissions are a little more evenly distributed with the lowest height range, <120 feet, having the greatest emissions followed closely by the highest range. Thus, relatively small boilers and internal combustion engines probably emit slightly more NO_x as a group than do power plants. Nearly all VOC emissions come from the lowest stack height range. This indicates predominance of evaporative point source categories. These data show that nearly all VOC emissions (both point and area) are emitted below 120 feet. Over two-thirds of the total emissions of NO_x also is released below 120 feet. On the other hand, nearly 40% of all SO_2 is emitted at heights above 480 feet.

The county emission density summary was derived from data used to generate the density maps included in Chapter 2 of the report. The highest range shown on the maps, >100 tons/square mile, is divided into two ranges in the table for illustrative purposes. For SO_2, the counties in the two highest ranges shown in the table result from power plants located in the east, primarily in the Ohio Valley and Great Lakes areas. These counties represent only 4% of those in the nation but have 54% of total emissions. The two counties with densities over 1,000 tons/square mile are Gallia, Ohio, and Marshall, West Virginia. Both have two power plants that are in the top 25 emitters in the country. Counties in the lowest density range represent 84% of all counties but only 10% of total emissions. For NO_x, the counties in the two highest ranges shown in the table result from

either power plants or highway vehicles. These counties represent only 3% of those in the nation but contribute 27% of total emissions. The only county with a density over 1,000 tons/square mile is New York City-Manhattan. Counties in the lowest density range represent 78% of all counties but only 24% of total emissions. Due to the greater area source influence, NO_x emissions are more evenly distributed among the ranges than are those for SO_2. For VOC, the counties in the two highest ranges shown in the table result from solvent use and highway vehicles. These counties represent only 2% of all counties in the nation but contribute 29% of total emissions. The six counties with densities over 1,000 tons/square mile - Manhattan, Kings (New York), Baltimore, St. Louis, Denver, and San Francisco - are heavily urbanized with relatively small geographic areas. Counties in the lowest density range represent 78% of all counties but only 27% of total emissions. Since area sources have a greater influence on VOC than on NO_x, emissions of VOC are even more evenly distributed among the density ranges than are those for NO_x.

The comparison of NAPAP, Trends, and Work Group 3B emissions of SO_2 and NO_x shows reasonable agreement. NAPAP total SO_2 emissions are greater than Work Group 3B by 3% and than Trends by 5.5%. NAPAP and Work Group 3B/Trends emissions compare well for all categories except non-utility combustion. The difference in this category is due to fuel use differences along with differences in sulfur content and control efficiency. NAPAP total NO_x emissions are greater than Work Group 3B by 11.8% and than Trends by 4%. The greatest difference between NAPAP and Work Group 3B occurs for the electric utility category. Although some of this variation is caused by fuel differences, most is believed to be a result of different emission factors and control efficiencies. The differences between NAPAP and Trends occur for the electric utility, non-utility combustion, and transportation categories. NAPAP emissions are higher for the first two categories and lower for the last. As was the case for the Work Group 3B comparison, some of the variation is a result of fuel differences but most is likely to be caused by different emission factors and control efficiencies. The non-utility combustion category variation occurs for the same reasons as the variation in the utility category except that the non-utility category may be more affected by fuel differences. The transportation category variation occurs because more detailed traffic data are used in developing the Trends estimate. Although these detailed traffic data are available on a national basis, only a very few areas in the country maintain data with this detail. Thus, insufficient detailed data exist for use in NAPAP.

DATA EVALUATION

Version 3.0 of NAPAP represents the best detailed inventory of emissions on a national scale that has been developed to date. Nevertheless, additional improvements would still be desirable. Over 80% of the NAPAP emissions truly represent 1980. Over 90% are in the range from 1978 to 1981. Future efforts to improve NAPAP will focus on major point sources that currently do not have a 1980 year of record. Emissions of SO_2 and NO_x tend to be dominated by a relatively small number of very large sources.

The 1,000 largest emitting plants account for about 84% of total SO_2 emissions. The 1,000 largest emitting plants account for about 42% of total NO_x emissions (about 68% of the emissions from all stationary sources). Many of these large emitting facilities are electric utility plants and non-ferrous smelters for which extensive quality assurance efforts have already been performed. A review of the data for other large emitting plants would be desirable. To a limited extent, this activity can be completed using NAPAP resources. In addition, EPA is currently working with selected state agencies to review the top 50 or so largest emitting plants in each state. Results of this effort may also benefit NAPAP.

One of the principal uses of the NAPAP inventory will be to support atmospheric long range transport and acid deposition modeling activities. In addition to emissions estimates, these models need location coordinates and stack parameters for major point sources. Currently, about 80% of point source SO_2 and NO_x emissions occur at sources with complete stack data and valid UTM coordinates. About 2-5% of the sources account for most of the 20% of emissions associated with sources that are lacking some stack parameters or valid coordinates. An effort will be made to collect the missing data for these sources, if possible. It should be noted that sources with invalid coordinates have at present a default value corresponding to the county centroid.

FUTURE ACTIVITIES

The bulk of the Task Group B emission inventory resources remaining in FY 84 and FY 85 will be used to try to improve NAPAP to meet the needs of Eulerian modeling activities. The Eulerian models under development require additional pollutants not now in NAPAP, speciation of VOC and NO_x emissions, hourly temporal resolution of emissions, and spatial resolution of data into small grid zones covering the entire U.S. (48 states and the District of Columbia). At projected resource levels and the requested time frame (September 1984 for a preliminary data set and September 1985 for the final inventory), the Eulerian modeling requirements for an emission inventory will have to be met using existing computer software to the extent possible, and perhaps, a number of simplifying assumptions to achieve adequate temporal, spatial, and species resolution of the data. The quality of emissions estimates for additional pollutants to be included may be limited.

Additional activities are planned for NAPAP that would support Eulerian modeling, but would be of interest for other purposes as well. These include incorporation of emissions data for Canada into NAPAP, coordination with Task Group A to include natural emissions sources into NAPAP, and a statistical evaluation of the uncertainty of NAPAP emissions estimates. Successful completion of these activities is contingent upon the availability of adequate future funding.

CHAPTER 1

INTRODUCTION

BACKGROUND

In 1980, Congress established the National Acid Precipitation Assessment Program (NAPAP) to coordinate and expand research relevant to the problems posed by acid deposition in and around the United States. The program is organized and managed through the Interagency Task Force on Acid Precipitation (ITFAP) and ten subordinate task groups coordinating specific technical areas of research. One of the groups is Task Group B which is responsible for man-made sources. A major objective of Group B is the development and maintenance of detailed 1980 and 1984 emissions inventories to support acid deposition research and analysis. The most significant uses of the inventories are for policy analysis and to support both Eulerian and Lagrangian long range transport/acid deposition models.

OBJECTIVES

The objectives of the effort reported in this document were to develop the initial 1980 base year emission inventory, evaluate its quality and comprehensiveness, and identify actions needed for further refinement of the data base in the future. The project required development of a central, quality-assured data base of emissions of pollutants of interest for acid deposition research and modeling. The data needed consist of accurate emissions estimates for the 1980 base year, disaggregated as appropriate by geographic region, time period, and chemical species. The area to be covered includes the 48 contiguous states of the U.S. and the District of Columbia. Eventually, the ten provinces and two territories of Canada will be incorporated into the data base as well. The pollutants believed to be most important in acid deposition processes (sulfur dioxide, nitrogen oxides, primary sulfate, VOCs, ammonia, chlorides, fluorides, alkaline dust, and others) were to be addressed.

PROJECT APPROACH

The starting point for the 1980 NAPAP data base was the 1980 "snapshot" data file of the National Emissions Data System (NEDS), maintained by the U.S. Environmental Protection Agency (EPA) at Research Triangle Park, North Carolina. NEDS contains point source data for major stationary sources of air pollution, as reported to EPA by state air pollution control agencies, and county-level area source data, as estimated by EPA based on published

references and other statistical information. The area source emissions account for all mobile sources and small stationary sources not included in the point source file so as to give a complete accounting of total emissions from all sources. The bulk of the effort completed thus far on this project has involved the point source data.

The NEDS inventory covers the entire country and includes the point source geographic detail desired for NAPAP. However, NEDS is capable of reporting emissions for only five pollutants (particulates, SO_2, NO_x, VOC, and CO) and has no capability for reporting emissions for a time period of less than one year. In addition, even though the point source data from NEDS are nominally described as being for base year 1980, the NEDS data base actually contains data with other years of record extending as far back as 1970. For these reasons, a decision was made to use the Emissions Inventory System (EIS) instead of NEDS to store the NAPAP data base.

EIS/PS (for point sources) and EIS/AS (for area sources) include all NEDS data fields and more and have the capability of tracking more than five pollutants. Conversion programs are available to translate NEDS to EIS and back again. EIS has been installed and has been running successfully at EPA's National Computer Center (NCC) for several years. Finally, the EIS file structure and the EIS retrieval and reporting programs are especially useful for managing a data base and maintaining an audit trail.

Engineering-Science (ES) was contracted by EPA to convert the NEDS data to EIS format, perform a quality assurance review of the data, update the NAPAP files with appropriate corrections and other data improvements, and to maintain an audit trail of all changes made to the data base. In addition, ES has provided copies of the data base and other printed report summaries to the research community.

Quality assurance activities for point sources completed thus far have involved:

- Incorporating the latest available EPA emission factors.
- Substitution of point source data from NEDS files other than the 1980 "snapshot" in order to build a NAPAP data base more representative of 1980.
- Adding county centroid latitude and longitude for point sources with missing UTM coordinates.
- Updating fuel type, quantity and quality data, source classification codes (SCCs), control equipment and efficiency, seasonal throughput, and SO_2 emissions data for electric utilities based on data files compiled by E.H. Pechan and Associates from DOE data sources.
- Comparison of summarized NAPAP emission estimates with similar data compiled previously by Work Group 3B under the U.S.-Canada Memorandum of Intent on Transboundary Air Pollution.

- Substitution of non-utility point source data for 15 northeastern states, based on data compiled for the Northeast Corridor Regional Modeling Project (NECRMP).

In addition to these improvements, ES has also developed seasonal allocation factors for area source emissions.

REPORT ORGANIZATION

Chapter 2 of this report summarizes emissions data from the current version of the NAPAP data base. Chapter 3 presents an evaluation of the quality of these data. Chapters 4 and 5 discuss the detailed activities that have been completed to develop the current version of the NAPAP data base and identify future activities planned to make additional refinements to the data. Various appendices present additional statistical and graphical information on the current status of the data.

CHAPTER 2

EMISSIONS SUMMARY

INTRODUCTION

The following tables and graphs contain data obtained from the current version of the NAPAP data base. This version (referred to as Version 3.0) was created in May 1984. This data base contains point source information for 50,224 plants and 201,131 emission points within these plants (an emission point generally corresponds to a stack or other defined point of release of emissions). A total of 3,069 area source records corresponding to each of the counties or county equivalents in the 48 states and the District of Columbia are also represented.

SUMMARY OF EMISSIONS BY STATE

A summary of SO_2, NO_x, and VOC emissions by state for the NAPAP inventory is provided in Table 2.1. Statewide emissions are divided into point and area source components to illustrate their relative contribution to total emissions of each pollutant. Area source emissions represent a small percentage of total SO_2 emissions but nearly half of total NO_x emissions and more than three-quarters of total VOC emissions. States with the greatest SO_2 emissions are Ohio, Pennsylvania, and Indiana. States with the greatest NO_x emissions are Texas, California, and Ohio while for VOC, Texas and California have the greatest emissions.

SUMMARY OF EMISSIONS BY SOURCE CATEGORY

Figures 2.1 through 2.3 present point source emissions summarized by Standard Industrial Classification (SIC). In addition, the number of emitting points according to emission size ranges are shown. Electric utilities are major contributors to total SO_2 and NO_x emissions and this is readily apparent on the right side of Figures 2.1 and 2.2. Other noteworthy SO_2 and NO_x contributors, although much less significant, appear to be within the chemical, petroleum refining, and primary metals industries, presumably as a result of fuel combustion. With regard to VOC emissions, Figure 2.3 indicates that emissions occur from a wide variety of industries with primary contributors to total emissions being the chemical and petroleum refining categories, which also have the largest number of sources emitting 100 tons per year or more.

TABLE 2.1

NATIONAL SUMMARY OF NAPAP EMISSIONS BY STATE (PRELIMINARY DATA)
(10^3 TONS/YEAR)

State	SO_2			NO_x			VOC		
	Point	Area	Total	Point	Area	Total	Point	Area	Total
Alabama	774	76	850	273	252	525	73	351	424
Arizona	824	20	844	141	153	294	13	228	241
Arkansas	59	30	89	65	167	232	14	230	244
California	416	118	534	455	868	1,323	417	1,691	2,108
Colorado	114	20	134	137	155	292	21	300	321
Connecticut	51	18	69	41	103	144	44	259	303
Delaware	105	22	127	36	33	69	26	48	74
Dist. of Col.	11	6	17	5	22	27	1	43	44
Florida	1,124	78	1,202	246	383	629	23	725	748
Georgia	847	30	877	279	308	587	28	495	523
Idaho	36	20	56	9	82	91	6	205	211
Illinois	1,360	99	1,459	655	462	1,117	208	768	976
Indiana	1,746	134	1,880	536	324	860	117	472	589
Iowa	366	24	390	167	182	349	31	241	272
Kansas	198	33	231	302	290	592	81	241	322
Kentucky	1,113	45	1,158	373	231	604	125	280	405
Louisiana	343	158	501	568	253	821	322	299	621
Maine	122	12	134	21	43	64	20	73	93
Maryland	273	23	296	114	164	278	76	270	346
Massachusetts	317	45	362	88	184	272	108	444	552
Michigan	844	34	878	378	368	746	238	730	968
Minnesota	242	21	263	229	227	456	63	360	423
Mississippi	256	50	306	99	196	295	52	234	286
Missouri	1,236	61	1,297	349	258	607	177	429	606
Montana	146	22	168	28	102	130	12	203	215
Nebraska	65	12	77	92	118	210	46	119	165
Nevada	140	7	147	76	47	123	4	73	77
New Hampshire	102	5	107	30	30	60	20	69	89
New Jersey	234	69	303	160	274	434	155	562	717
New Mexico	247	11	258	224	83	307	52	109	161
New York	787	77	864	321	427	748	143	988	1,131
North Carolina	621	32	653	302	268	570	108	465	573
North Dakota	95	19	114	103	65	168	2	46	48
Ohio	2,655	50	2,705	665	554	1,219	165	914	1,079
Oklahoma	86	16	102	177	285	462	72	297	369
Oregon	31	25	56	53	175	228	40	279	319
Pennsylvania	1,770	82	1,852	595	487	1,082	240	802	1,042
Rhode Island	10	4	14	6	30	36	13	84	97
South Carolina	324	18	342	154	148	302	228	259	487
South Dakota	34	7	41	22	55	77	3	88	91
Tennessee	1,103	31	1,134	336	237	573	157	353	510
Texas	1,081	260	1,341	1,543	1,943	3,486	940	1,710	2,650
Utah	89	27	116	80	95	175	11	134	145
Vermont	3	7	10	1	43	44	4	36	40
Virginia	338	48	386	160	251	411	105	358	463
Washington	280	46	326	131	219	350	48	373	421
West Virginia	1,091	13	1,104	352	121	473	14	124	138
Wisconsin	668	20	688	205	221	426	76	372	448
Wyoming	224	25	249	184	115	299	20	74	94
Totals	25,001	2,110	27,111	11,566	12,101	23,667	4,962	18,307	23,269

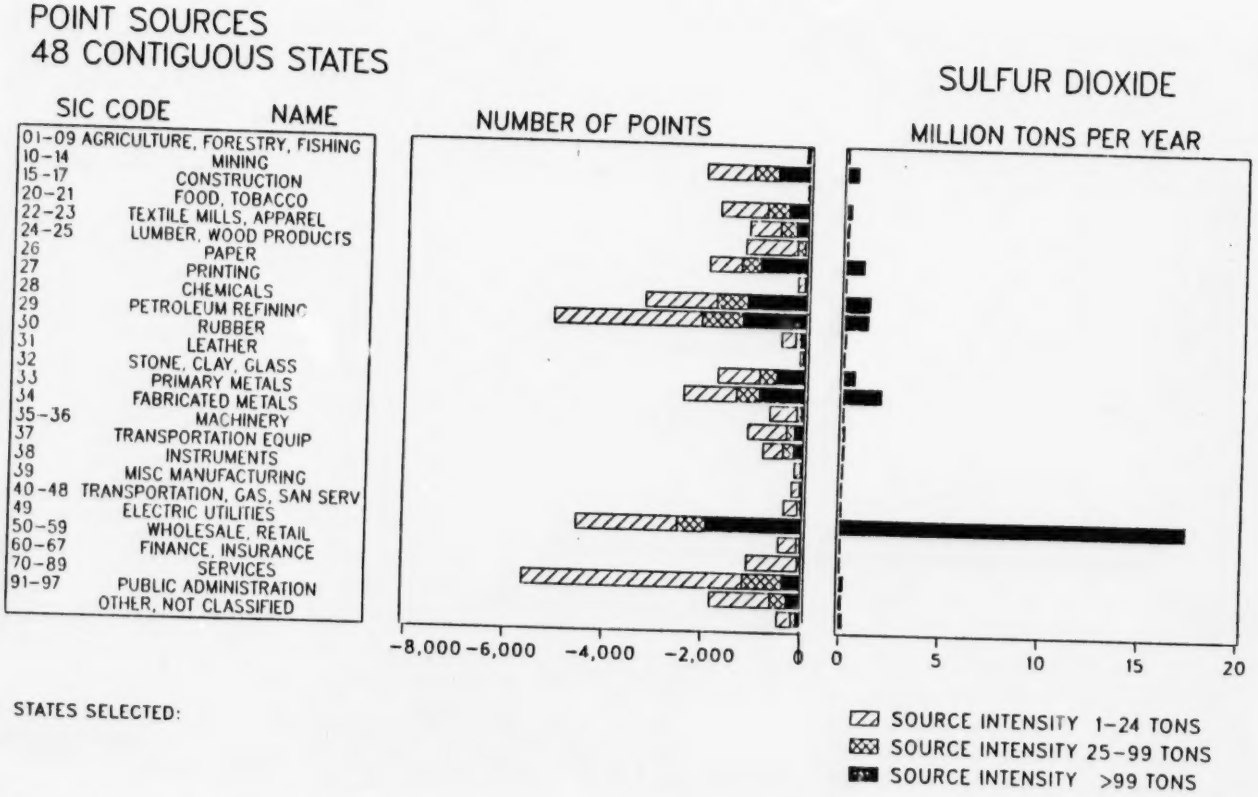

Figure 2.1 Number of Points and Emissions by SIC Category (Preliminary Data)

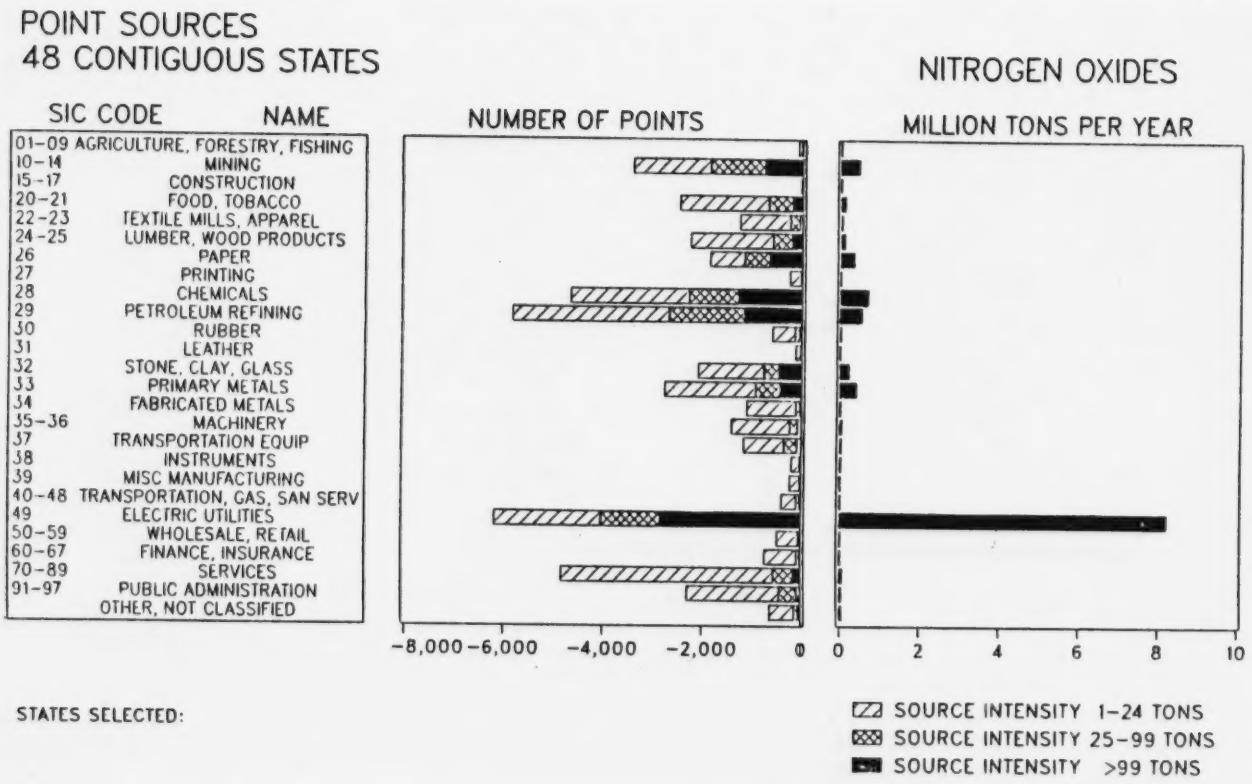

Figure 2.2 Number of Points and Emissions by SIC Category (Preliminary Data)

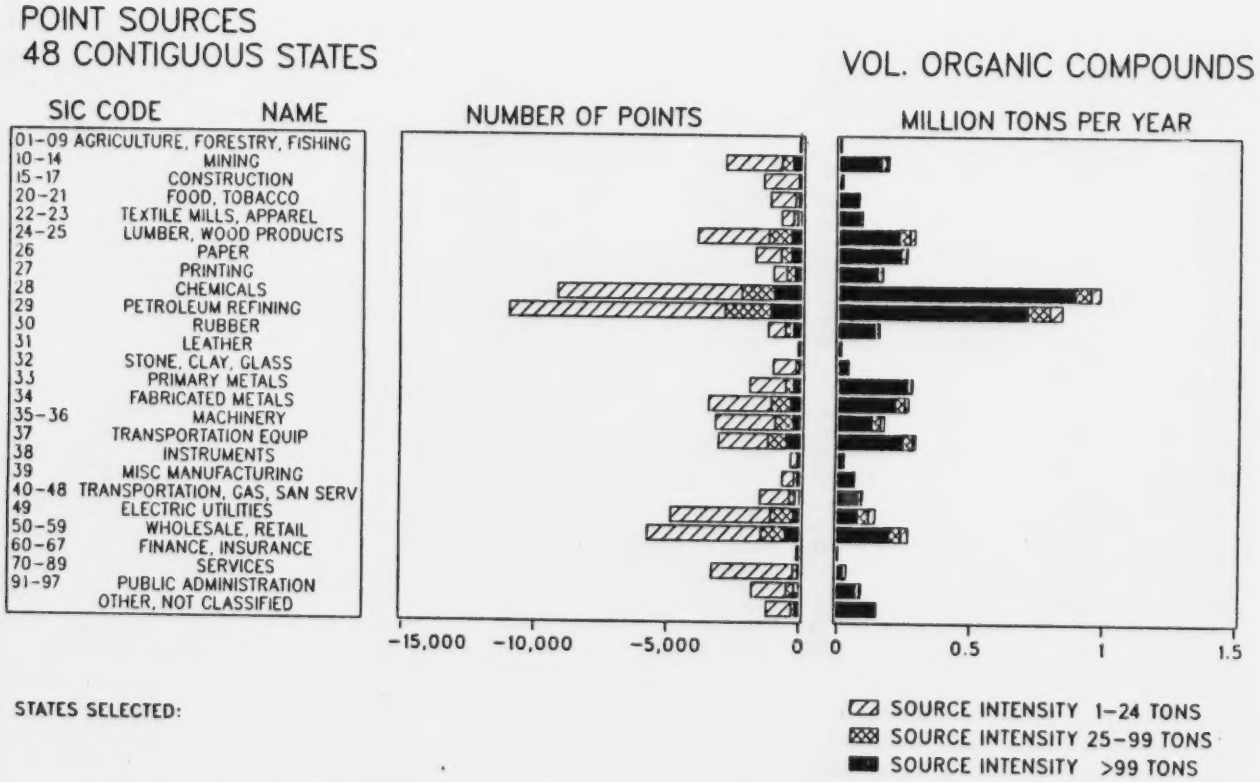

Figure 2.3 Number of Points and Emissions by SIC Category (Preliminary Data)

A summary of NAPAP point and area source emissions by OAQPS emissions trends categories is shown in Table 2.2. Five main categories are included with subcategory emissions shown as appropriate. For the transportation category, which is a significant emitter of both NO_x and VOC, highway vehicles contribute about 77% of NO_x emissions and 86% of VOC emissions. Stationary source fuel combustion produces the greatest amounts of SO_2 and NO_x with the electric utility subcategory emitting nearly 80% of the SO_2 and 61% of the NO_x. The industrial combustion subcategory is also significant. Industrial processes emit substantial amounts of both SO_2 and VOC. Only electric utilities emit more SO_2 and only highway vehicles and miscellaneous solvent use have greater VOC emissions. The solid waste and miscellaneous categories are of lesser importance except for the VOC contribution made by miscellaneous solvent use.

SUMMARY OF HIGHEST EMITTING PLANTS

In any emission inventory to be used for atmospheric modeling, it is useful to know which sources are the highest emitters of each pollutant of concern because they may have a substantial impact on modeling results. By ranking the sources and summing their contributions to total emissions, an idea of the number of sources it takes to account for a certain percentage of total point source emissions can be obtained. A summary of such information for SO_2, NO_x, and VOC is as follows:

	Cumulative Number of Plants - Ranked from Highest to Lowest Emissions	Cumulative Emissions (percent of total)	Minimum Plant Size (tons/year)
SO_2:	50	35	95,700
	206	65	25,000
	905	90	3,200
	1,679	96	1,000
	16,963	100	1
NO_x:	50	24	37,900
	340	65	7,350
	1,440	90	920
	2,900	96	250
	18,769	100	1
VOC:	50	20	11,200
	655	65	1,400
	3,176	90	190
	4,768	95	100
	20,895	100	1

TABLE 2.2

SUMMARY OF NAPAP EMISSIONS BY OAQPS EMISSIONS TRENDS CATEGORIES (PRELIMINARY DATA)

(10^3 TONS/YEAR)

	SO_2	NO_x	VOC
Transportation			
Highway Vehicles	422	7,024	6,821
Air	12	117	175
Railroad	127	825	200
Vessels	231	138	417
Other Off-Highway	79	992	352
Subtotal	871	9,096	7,965
Stationary Source Fuel Combustion			
Electric Utilities	17,324	8,117	71
Industrial	3,707	4,484	1,005
Commercial/ Institutional	686	347	18
Residential	191	357	39
Subtotal	21,908	13,305	1,133
Industrial Processes	4,269	921	4,541
Solid Waste Disposal			
Incineration	46	42	374
Open Burning	9	67	354
Subtotal	55	109	728
Miscellaneous			
Forest Fires	5	139	837
Other Burning	3	97	482
Miscellaneous Organic Solvent	-	--	7,583
Subtotal	8	236	8,902
Total	27,111	23,667	23,269

The locations of plants emitting more than 25,000 tons of SO_2 per year are shown in Figure 2.4.

SUMMARY OF AREA SOURCE EMISSIONS

Area source emissions by source category are shown in Table 2.3. For sulfur dioxide, the primary contribution to total area source emissions (over 57%) results from fuel combustion at stationary sources, while for nitrogen oxides it is the mobile sources that contribute heavily (over 75%) to total area source emissions. For VOC, the primary contribution (over 78%) is from gasoline vehicles, solvent purchased, and gasoline marketed. Area source emissions represent 8% of total SO_2 emissions, over 51% of total NO_x emissions, and 79% of all VOC emissions in the NAPAP inventory.

SUMMARY OF EMISSIONS BY FUEL TYPE

Table 2.4 shows a national summary of SO_2 and NO_x emissions by fuel type from the NAPAP inventory. As expected, SO_2 emissions are largely the result of coal combustion. For NO_x, most emissions result from coal combustion, but natural gas and to a lesser extent, fuel oil, also contribute significantly to NO_x. This table represents only emissions from point sources. For area sources, SO_2 emissions are small. NO_x area source emissions come mostly from highway vehicles consuming gasoline and diesel fuel.

SUMMARY OF EMISSIONS BY SEASON

Tables 2.5 through 2.7 show SO_2, NO_x, and VOC emissions for each state by season. These were derived from the NAPAP inventory using the seasonal throughput percentages shown on each point source record in the file and the area source seasonal allocation factors for each county as shown in Appendix F. Although some variations occur from state to state, nationwide emissions of SO_2 and NO_x are greatest in the winter months followed by the summer months. Emissions in the spring and fall are somewhat less and roughly equivalent. Winter emissions of SO_2 are higher than those in summer by about 6.5% and than those in the months with lowest emissions (spring) by 11.9%. Winter emissions of NO_x are higher than those in summer by only 1.3% and than those in the season with lowest emissions (spring) by 6.3%. Emissions of VOC are greatest in the summer months followed closely by the fall (less than 1% difference). Summer emissions of VOC are higher than those in the months with lowest emissions (winter) by 8.0%.

SUMMARY OF EMISSIONS BY STACK HEIGHT RANGES

Tables 2.8 through 2.10 show SO_2, NO_x, and VOC emissions according to stack height ranges for each state. The stack height ranges were chosen somewhat arbitrarily but adequately demonstrate how emissions vary

Figure 2.4 Plants Emitting More Than 25,000 Tons SO_2 Annually in the NAPAP Inventory (Preliminary Data)

TABLE 2.3

SUMMARY OF NAPAP 1980 AREA SOURCE EMISSION INVENTORY
(PRELIMINARY DATA)
(10^3 TONS/YEAR)

Area Source Category Description	Sulfur Dioxide Emissions	Nitrogen Oxide Emissions	Volatile Organic Emissions
Residential Fuel Use	191	357	39
Commercial Fuel Use	390	211	7
Light Industrial Fuel Use	632	2,123	727
Incineration/Burning	18	78	667
Highway Vehicles - Gasoline	220	5,029	6,740
Diesel Fuel Use	408	3,812	633
Aircraft	12	117	175
Vessels	231	138	417
Solvent Purchased	---	---	6,618
Gasoline Marketed	---	---	965
Miscellaneous Burning	8	236	1,319
Total	2,110	12,101	18,307

Note: State totals of area source emissions are given in Table 2.1.

TABLE 2.4

SUMMARY OF SO_2 AND NO_x EMISSIONS BY FUEL TYPE FOR POINT SOURCES (PRELIMINARY DATA) (10^3 TONS/YEAR)

Fuel	SO_2	NO_x
Anthracite Coal	63	26
Bituminous Coal	17,076	6,702
Lignite Coal	373	374
Residual Oil	2,680	1,369
Distillate Oil	496	670
Natural Gas	475[b]	1,664
Process Gas	98	50
Coke	8	5
Wood	15	77
Other[a]	27	7
Total	21,311	10,944

[a] Includes LPG, bagasse, solid waste, and liquid waste used as fuel.

[b] Value higher than expected as a result of EIS data summary limitations (see note below).

NOTE: Based on first SCC encountered for each emission point.

TABLE 2.5

SUMMARY OF SO_2 EMISSIONS BY SEASON BY STATE (PRELIMINARY DATA)
(10^3 TONS/YEAR)

State	Winter[a]	Spring[b]	Summer[c]	Fall[d]	Total
Alabama	225	179	225	221	850
Arizona	251	251	153	189	844
Arkansas	22	20	26	21	89
California	136	129	135	134	534
Colorado	37	31	32	34	134
Connecticut	22	16	14	17	69
Delaware	34	31	29	33	127
Dist. of Col.	8	3	3	3	17
Florida	293	294	336	279	1,202
Georgia	219	191	258	209	877
Idaho	19	15	7	15	56
Illinois	405	340	372	342	1,459
Indiana	507	450	470	453	1,880
Iowa	103	90	110	87	390
Kansas	59	51	65	56	231
Kentucky	305	249	318	286	1,158
Louisiana	147	131	105	118	501
Maine	39	37	27	31	134
Maryland	90	73	71	62	296
Massachusetts	108	101	89	64	362
Michigan	239	214	219	206	878
Minnesota	78	68	58	59	263
Mississippi	79	70	78	79	306
Missouri	337	286	370	304	1,297
Montana	59	57	25	27	168
Nebraska	21	21	21	14	77
Nevada	34	39	38	36	147
New Hampshire	31	26	23	27	107
New Jersey	90	67	68	78	303
New Mexico	65	61	66	66	258
New York	255	205	199	205	864
North Carolina	173	157	172	151	653
North Dakota	31	27	25	31	114
Ohio	750	629	672	654	2,705
Oklahoma	27	26	21	28	102
Oregon	14	13	13	16	56
Pennsylvania	481	425	474	472	1,852
Rhode Island	4	3	4	3	14
South Carolina	88	79	95	80	342
South Dakota	11	14	5	11	41
Tennessee	310	257	309	258	1,134
Texas	343	318	344	336	1,341
Utah	30	30	27	29	116
Vermont	3	3	2	2	10
Virginia	110	86	95	95	386
Washington	86	81	72	87	326
West Virginia	293	273	271	267	1,104
Wisconsin	189	176	170	153	688
Wyoming	66	58	59	66	249
Totals	7,326	6,451	6,840	6,494	27,111

[a] December - February
[b] March - May
[c] June - August
[d] September - November

TABLE 2.6

SUMMARY OF NO_x EMISSIONS BY SEASON BY STATE (PRELIMINARY DATA)
(10^3 TONS/YEAR)

State	Winter[a]	Spring[b]	Summer[c]	Fall[d]	Total
Alabama	135	119	138	133	525
Arizona	74	69	81	70	294
Arkansas	61	55	63	53	232
California	330	322	337	334	1,323
Colorado	77	69	72	74	292
Connecticut	40	34	33	37	144
Delaware	18	16	17	18	69
Dist. of Col.	8	7	6	6	27
Florida	155	159	167	148	629
Georgia	146	141	156	144	587
Idaho	19	25	23	24	91
Illinois	296	272	279	270	1,117
Indiana	237	211	210	202	860
Iowa	93	84	86	86	349
Kansas	152	138	155	147	592
Kentucky	153	139	161	151	604
Louisiana	203	198	214	206	821
Maine	17	16	15	16	64
Maryland	76	68	68	66	278
Massachusetts	75	68	65	64	272
Michigan	202	183	177	184	746
Minnesota	118	113	112	113	456
Mississippi	75	68	74	78	295
Missouri	152	143	162	150	607
Montana	28	33	33	36	130
Nebraska	53	55	55	47	210
Nevada	27	32	33	31	123
New Hampshire	16	14	14	16	60
New Jersey	117	105	104	108	434
New Mexico	80	72	79	76	307
New York	208	178	180	182	748
North Carolina	147	140	147	136	570
North Dakota	43	37	40	48	168
Ohio	331	292	299	297	1,219
Oklahoma	118	112	117	115	462
Oregon	53	56	58	61	228
Pennsylvania	280	256	272	274	1,082
Rhode Island	9	9	9	9	36
South Carolina	76	76	78	72	302
South Dakota	19	19	18	21	77
Tennessee	150	135	148	140	573
Texas	852	833	924	877	3,486
Utah	44	43	43	45	175
Vermont	10	11	12	11	44
Virginia	109	96	103	103	411
Washington	89	93	74	94	350
West Virginia	126	115	117	115	473
Wisconsin	113	105	106	102	426
Wyoming	78	69	73	79	299
Totals	6,088	5,703	6,007	5,869	23,667

a December - February
b March - May
c June - August
d September - November

TABLE 2.7

SUMMARY OF VOC EMISSIONS BY SEASON BY STATE (PRELIMINARY DATA)
(10^3 TONS/YEAR)

State	Winter[a]	Spring[b]	Summer[c]	Fall[d]	Total
Alabama	102	107	109	106	424
Arizona	54	60	64	63	241
Arkansas	56	59	67	62	244
California	495	528	544	541	2,108
Colorado	72	75	88	86	321
Connecticut	75	75	76	77	303
Delaware	18	18	18	20	74
Dist. of Col.	10	12	12	10	44
Florida	188	200	180	180	748
Georgia	121	146	123	133	523
Idaho	27	55	64	65	211
Illinois	237	242	249	248	976
Indiana	155	146	150	138	589
Iowa	66	66	69	71	272
Kansas	77	79	83	83	322
Kentucky	92	94	112	107	405
Louisiana	161	152	154	154	621
Maine	22	22	25	24	93
Maryland	82	85	90	89	346
Massachusetts	136	136	140	140	552
Michigan	236	240	247	245	968
Minnesota	98	101	115	109	423
Mississippi	68	73	72	73	286
Missouri	143	148	159	156	606
Montana	28	58	64	65	215
Nebraska	39	39	43	44	165
Nevada	17	17	21	22	77
New Hampshire	22	21	23	23	89
New Jersey	178	179	180	180	717
New Mexico	41	42	41	37	161
New York	278	279	290	284	1,131
North Carolina	136	146	144	147	573
North Dakota	11	11	13	13	48
Ohio	266	267	275	271	1,079
Oklahoma	90	91	90	98	369
Oregon	63	84	84	88	319
Pennsylvania	258	255	267	262	1,042
Rhode Island	24	24	25	24	97
South Carolina	115	130	120	122	487
South Dakota	15	15	32	29	91
Tennessee	125	125	129	131	510
Texas	622	621	714	693	2,650
Utah	34	38	36	37	145
Vermont	10	10	10	10	40
Virginia	114	115	118	116	463
Washington	88	136	91	106	421
West Virginia	32	33	37	36	138
Wisconsin	104	110	120	114	448
Wyoming	21	21	26	26	94
Totals	5,522	5,786	6,003	5,958	23,269

[a] December - February
[b] March - May
[c] June - August
[d] September - November

TABLE 2.8

SUMMARY OF SO_2 EMISSIONS BY STACK HEIGHT RANGE BY STATE (PRELIMINARY DATA)
(10^3 TONS/YEAR)

State	Range 1	Range 2	Range 3	Range 4	Total
Alabama	83	123	166	402	774
Arizona	65	25	63	671	824
Arkansas	12	32	5	10	59
California	262	104	34	16	416
Colorado	35	26	38	15	114
Connecticut	13	9	25	4	51
Delaware	8	37	55	5	105
Dist. of Col.	2	6	3	0	11
Florida	431	178	297	218	1,124
Georgia	32	62	57	696	847
Idaho	7	9	1	19	36
Illinois	629	183	114	434	1,360
Indiana	367	150	355	874	1,746
Iowa	152	104	110	0	366
Kansas	192	0	0	6	198
Kentucky	114	37	195	767	1,113
Louisiana	182	143	13	5	343
Maine	37	54	31	0	122
Maryland	32	27	26	188	273
Massachusetts	99	25	117	76	317
Michigan	95	134	233	382	844
Minnesota	82	62	25	73	242
Mississippi	36	71	106	43	256
Missouri	32	115	447	642	1,236
Montana	22	27	19	78	146
Nebraska	25	28	3	9	65
Nevada	7	6	0	127	140
New Hampshire	12	32	58	0	102
New Jersey	108	75	51	0	234
New Mexico	45	35	84	83	247
New York	234	152	289	112	787
North Carolina	228	159	97	137	621
North Dakota	77	18	0	0	95
Ohio	114	222	660	1,659	2,655
Oklahoma	28	30	19	9	86
Oregon	23	6	2	0	31
Pennsylvania	105	272	329	1,064	1,770
Rhode Island	4	3	3	0	10
South Carolina	58	104	162	0	324
South Dakota	7	0	0	27	34
Tennessee	65	112	302	624	1,103
Texas	424	253	305	99	1,081
Utah	51	21	0	17	89
Vermont	2	1	0	0	3
Virginia	131	104	103	0	338
Washington	61	30	77	112	280
West Virginia	41	139	104	807	1,091
Wisconsin	48	159	279	182	668
Wyoming	37	82	46	59	224
Totals	4,956	3,786	5,508	10,751	25,001

Range No.	Stack Height Range
1	0-120 feet
2	121-240 feet
3	241-480 feet
4	>480 feet

TABLE 2.9

SUMMARY OF NO_x EMISSIONS BY STACK HEIGHT RANGE BY STATE (PRELIMINARY DATA)
(10^3 TONS/YEAR)

State	Range 1	Range 2	Range 3	Range 4	Total
Alabama	53	28	38	154	273
Arizona	34	7	14	86	141
Arkansas	11	22	5	27	65
California	246	176	29	4	455
Colorado	52	23	43	19	137
Connecticut	10	8	20	3	41
Delaware	3	15	16	2	36
Dist. of Col.	1	3	1	0	5
Florida	79	39	72	56	246
Georgia	24	23	24	208	279
Idaho	6	2	1	0	9
Illinois	275	54	74	252	655
Indiana	141	66	106	223	536
Iowa	58	46	63	0	167
Kansas	282	0	0	20	302
Kentucky	43	17	64	249	373
Louisiana	338	181	19	30	568
Maine	7	9	5	0	21
Maryland	21	16	21	56	114
Massachusetts	45	6	23	14	88
Michigan	59	58	144	117	378
Minnesota	111	20	28	70	229
Mississippi	22	32	28	17	99
Missouri	36	29	88	196	349
Montana	12	6	10	0	28
Nebraska	44	21	2	25	92
Nevada	14	7	1	54	76
New Hampshire	2	10	18	0	30
New Jersey	76	62	22	0	160
New Mexico	106	3	115	0	224
New York	107	67	110	37	321
North Carolina	96	65	60	81	302
North Dakota	84	19	0	0	103
Ohio	44	63	166	392	665
Oklahoma	35	87	45	10	177
Oregon	38	10	5	0	53
Pennsylvania	50	108	115	322	595
Rhode Island	2	2	2	0	6
South Carolina	20	54	80	0	154
South Dakota	3	2	0	17	22
Tennessee	63	31	91	151	336
Texas	921	324	195	103	1,543
Utah	38	14	5	23	80
Vermont	1	0	0	0	1
Virginia	62	47	51	0	160
Washington	20	21	90	0	131
West Virginia	25	44	38	245	352
Wisconsin	22	42	73	68	205
Wyoming	43	24	49	68	184
Totals	3,885	2,013	2,269	3,399	11,566

Range No.	Stack Height Range
1	0-120 feet
2	121-240 feet
3	241-480 feet
4	>480 feet

TABLE 2.10

SUMMARY OF VOC EMISSIONS BY STACK HEIGHT RANGE BY STATE (PRELIMINARY DATA)
(10^3 TONS/YEAR)

State	Range 1	Range 2	Range 3	Range 4	Total
Alabama	67	4	1	1	73
Arizona	12	0	0	1	13
Arkansas	13	1	0	0	14
California	411	5	1	0	417
Colorado	20	1	0	0	21
Connecticut	44	0	0	0	44
Delaware	24	1	1	0	26
Dist. of Col.	0	1	0	0	1
Florida	21	2	0	0	23
Georgia	22	4	1	1	28
Idaho	5	1	0	0	6
Illinois	206	1	0	1	208
Indiana	112	3	1	1	117
Iowa	28	2	1	0	31
Kansas	81	0	0	0	81
Kentucky	114	10	0	1	125
Louisiana	289	32	1	0	322
Maine	20	0	0	0	20
Maryland	60	1	15	0	76
Massachusetts	101	7	0	0	108
Michigan	224	9	5	0	238
Minnesota	62	1	0	0	63
Mississippi	42	9	1	0	52
Missouri	176	0	1	0	177
Montana	11	1	0	0	12
Nebraska	46	0	0	0	46
Nevada	4	0	0	0	4
New Hampshire	20	0	0	0	20
New Jersey	147	7	0	1	155
New Mexico	52	0	0	0	52
New York	135	7	0	1	143
North Carolina	100	7	1	0	108
North Dakota	2	0	0	0	2
Ohio	139	17	7	2	165
Oklahoma	68	3	1	0	72
Oregon	38	2	0	0	40
Pennsylvania	227	11	1	1	240
Rhode Island	13	0	0	0	13
South Carolina	227	1	0	0	228
South Dakota	3	0	0	0	3
Tennessee	135	20	0	2	157
Texas	877	60	3	0	940
Utah	10	1	0	0	11
Vermont	4	0	0	0	4
Virginia	101	4	0	0	105
Washington	36	12	0	0	48
West Virginia	7	3	3	1	14
Wisconsin	70	4	1	1	76
Wyoming	19	1	0	0	20
Totals	4,645	256	46	15	4,962

Range No.	Stack Height Range
1	0-120 feet
2	121-240 feet
3	241-480 feet
4	>480 feet

according to stack height. On a nationwide basis, stacks greater than 480 feet in height emit about twice as much SO_2 as stacks in any one of the other ranges. Emissions of NO_x are more evenly distributed with the greatest contribution from stacks of 120 feet or less in height. Nearly all VOC emissions (94%) come from stacks in the lowest range. Variations in the amount of emissions from each range occur from state to state for SO_2 and NO_x due primarily to differences in source category and fuel mix.

EMISSION DENSITY MAPS

Figures 2.5 through 2.7 show densities of SO_2, NO_x, and VOC emissions by county. The density ranges were chosen to highlight the relatively few counties with the highest emission densities. For the most part, the shaded counties on the SO_2 map represent power plant or smelter locations. The greatest SO_2 densities occur in the Ohio Valley and Great Lakes areas as well as in other scattered eastern locations. The shaded counties on the VOC map correspond primarily to population centers and concentrations of industries such as petroleum refining and petrochemicals. The shaded counties on the NO_x map represent a cross between those shaded on the SO_2 and VOC maps since the majority of NO_x emissions come from highway vehicles and power plants. For all three pollutants, the shaded counties, although relatively few in number, account for the bulk of nationwide emissions.

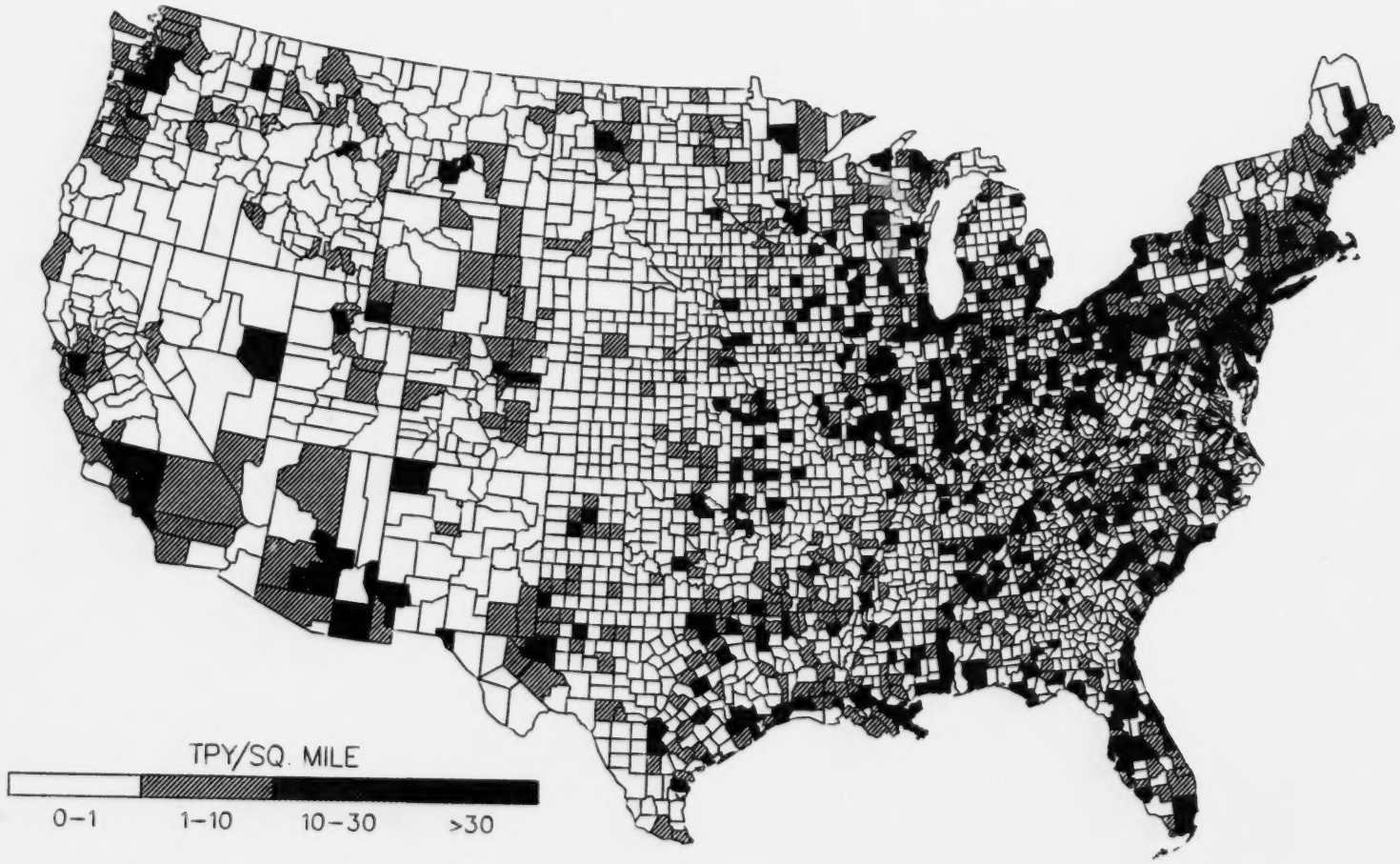

Figure 2.5 1980 SO_2 County Emission Density Map (Preliminary Data)

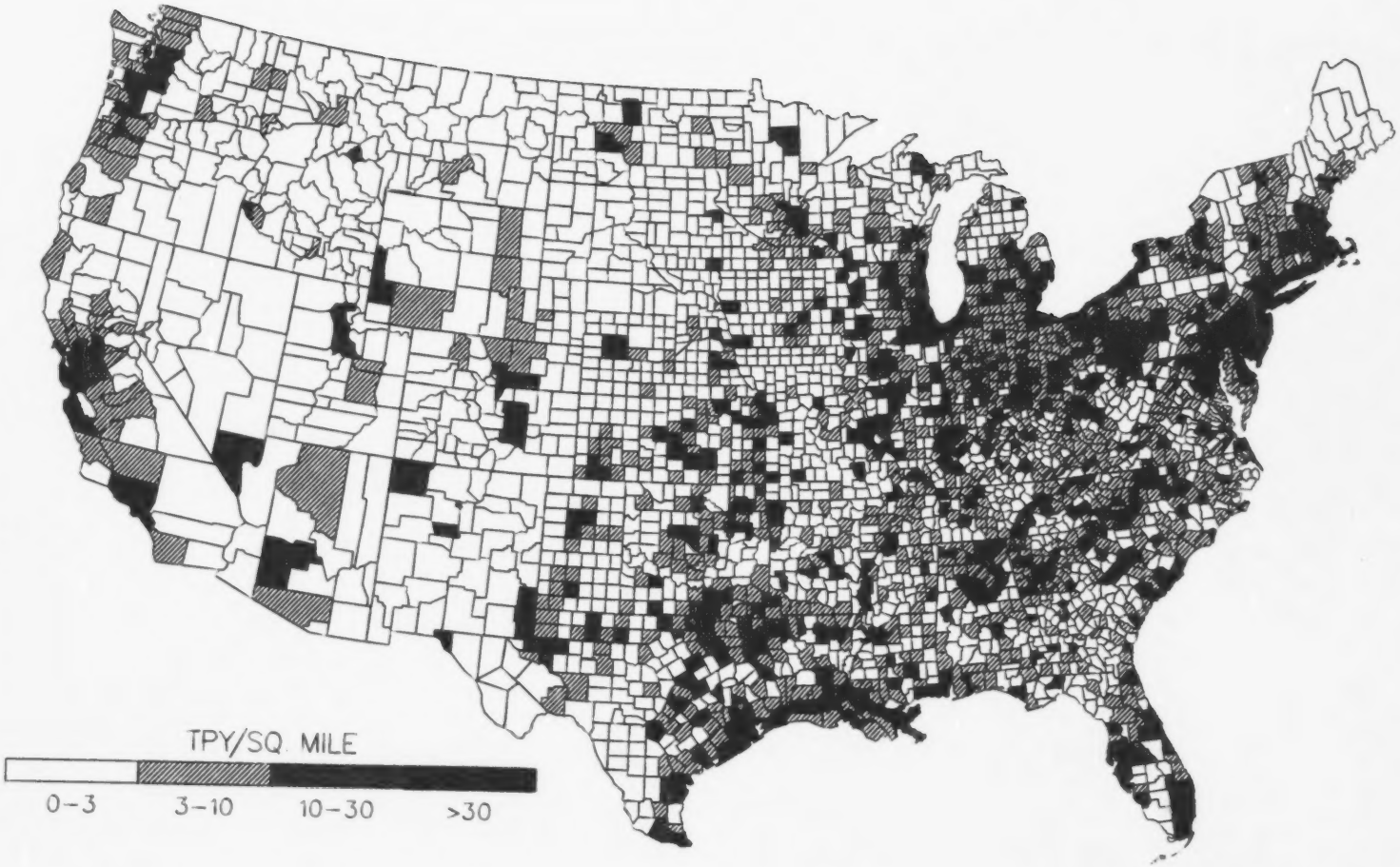

Figure 2.6 1980 NO_x County Emission Density Map (Preliminary Data)

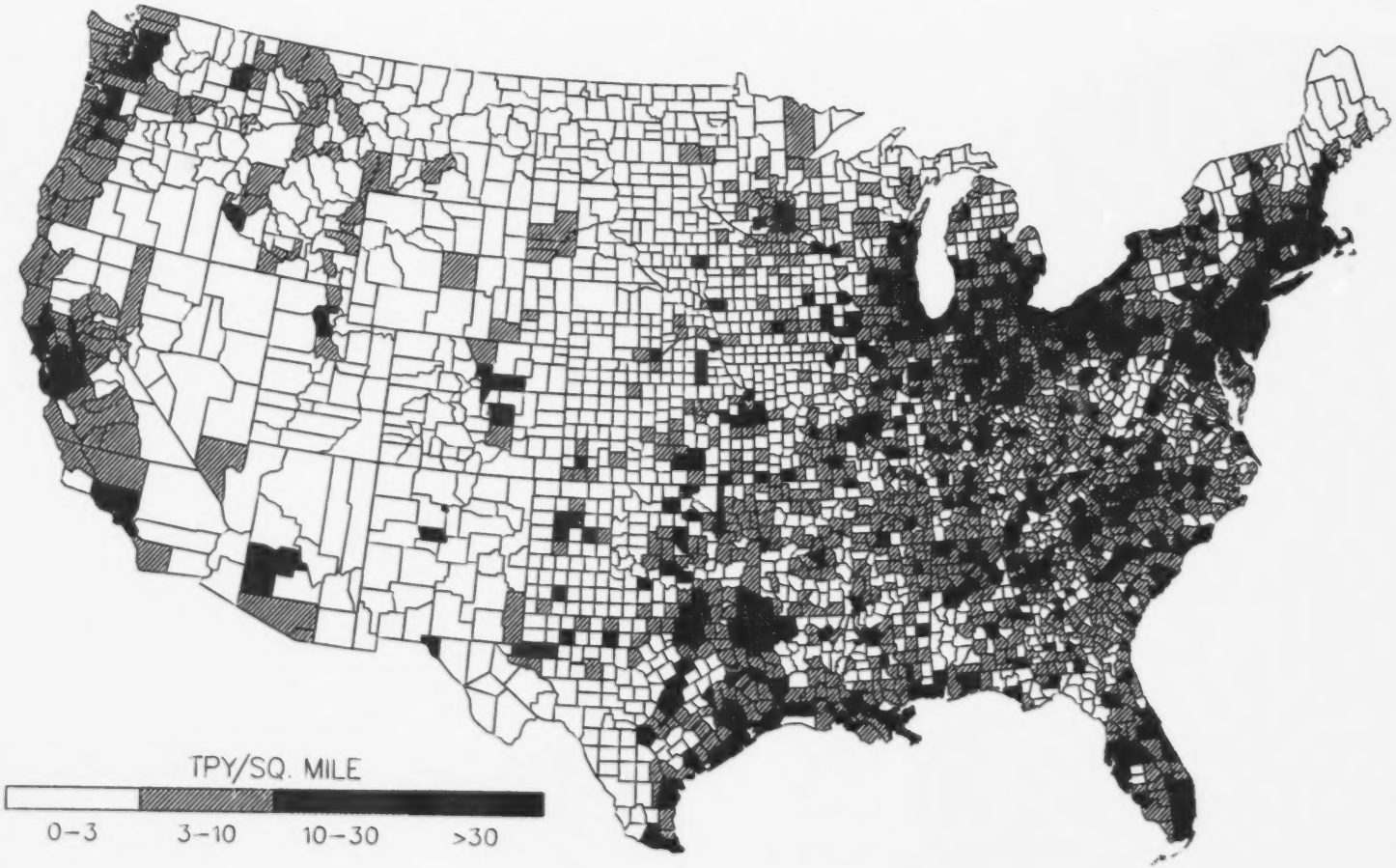

Figure 2.7 1980 VOC County Emission Density Map (Preliminary Data)

CHAPTER 3

DATA EVALUATION

INTRODUCTION

The previous chapter presented a summary of the data currently available from the NAPAP data base. This chapter will address efforts completed thus far in improving the quality of the data and provide at least a qualitative assessment of the current state of the data base.

Ideally, the accuracy, completeness, and timeliness of the NAPAP data (or any other emission inventory data base for that matter) would be measured by standard quantitative statistical techniques. Unfortunately, there are problems in determining the accuracy of an emission inventory since true emissions values against which calculated emissions estimates could be compared will probably never be known. Assessing the completeness (i.e., are all emission sources included, are all required data items present, etc.) of the data is possible to some extent, but it is difficult to define measures for completeness in some cases. For NAPAP, it is fairly straightforward to determine the timeliness of the data, since the stated objective of the NAPAP project was to develop an inventory solely for the 1980 base year.

TIMELINESS OF DATA

Figures 3.1 through 3.3 illustrate the distribution of total emissions by year of record in NAPAP for SO_2, NO_x, and VOC emissions. The year of record is indicated in the EIS/PS masterfile at each of the plant, point, and process levels. The distribution of emissions shown in Figures 3.1 through 3.3 refers to the specified year of record for emission points, since emissions estimates are stored at the level in EIS.

The original source of NAPAP data, a 1980 NEDS snapshot file, actually consisted of records which reflect years dating from before 1973 to after 1981. A primary objective in the development of the NAPAP inventory was to make it more representative of 1980, the intended base year. A number of improvements were made to the data as discussed in Chapter 4, many of which affected the year of record. The results of these changes are apparent in Figures 3.1 and 3.2. Whereas the distribution of the number of points by year of record (on the left) was not expected to change much from the original distribution, the distribution of emissions by year of record (on the right) does show a narrowing about 1980, because the sources reviewed and updated were the largest contributors. These distributions

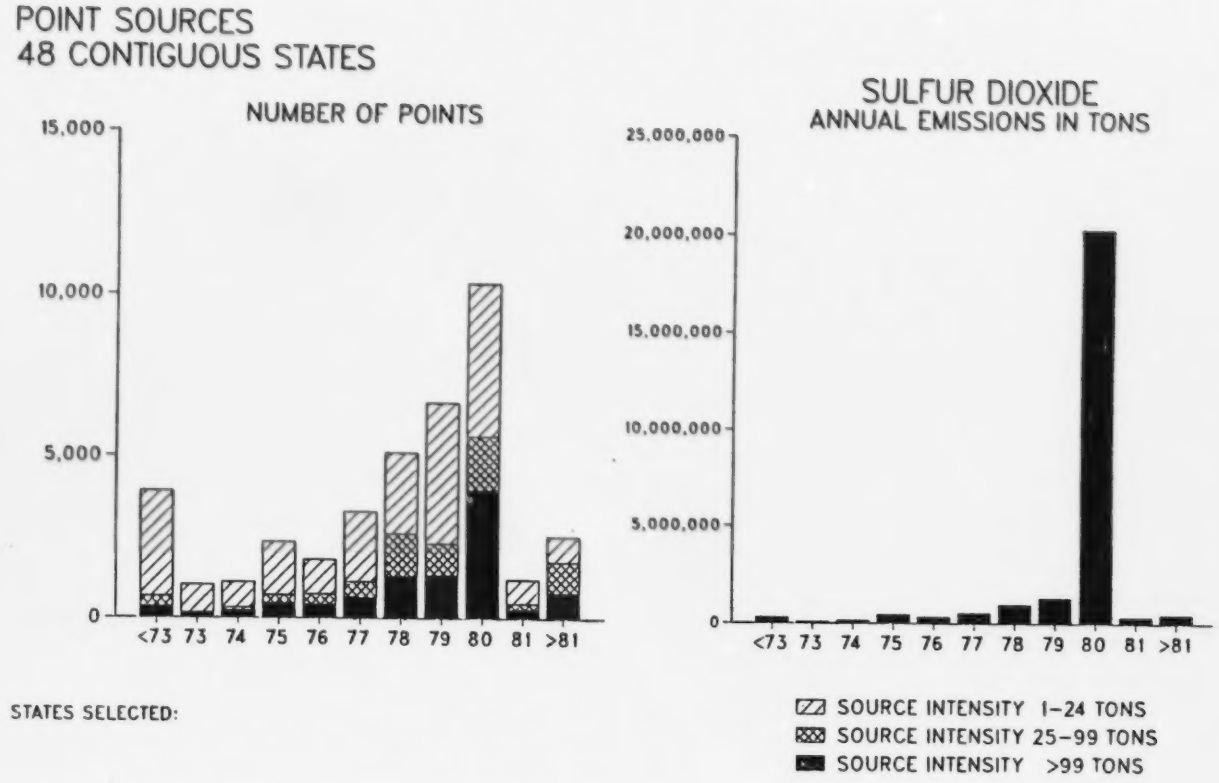

Figure 3.1 Number of Points and Emissions with Respect to Year of Record (Preliminary Data)

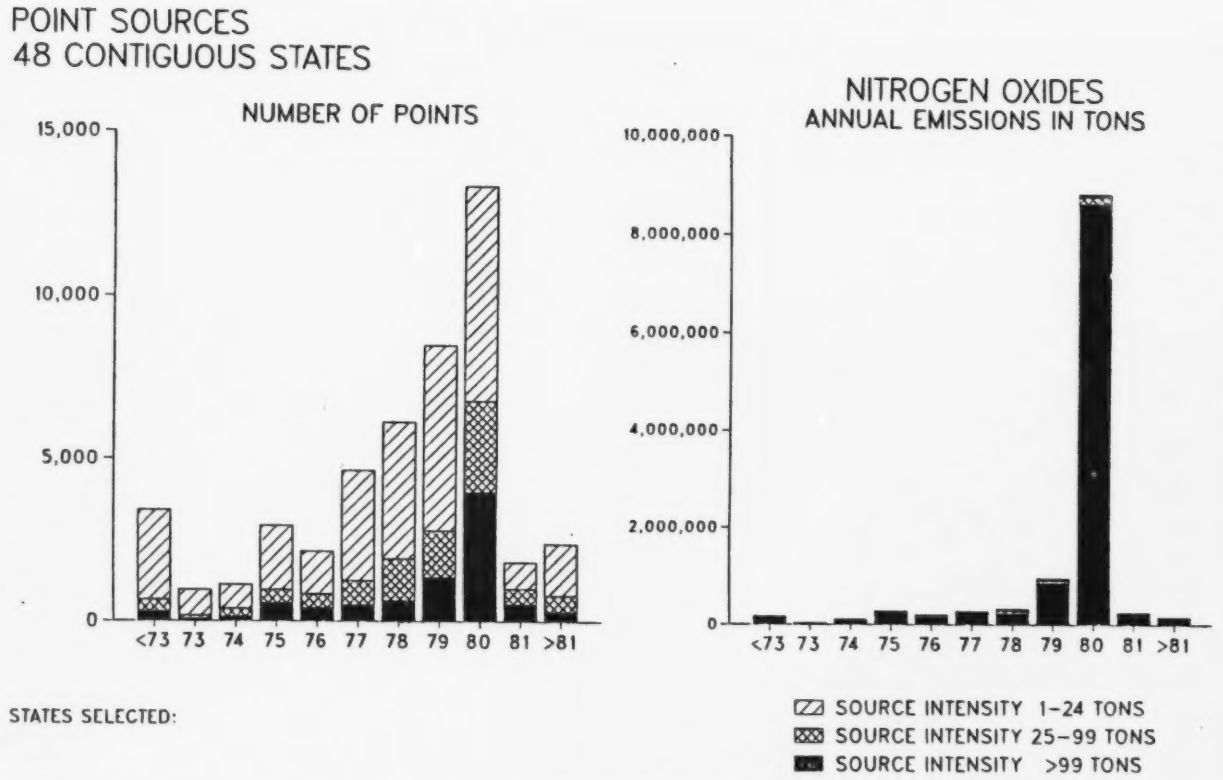

Figure 3.2 Number of Points and Emissions with Respect to Year of Record (Preliminary Data)

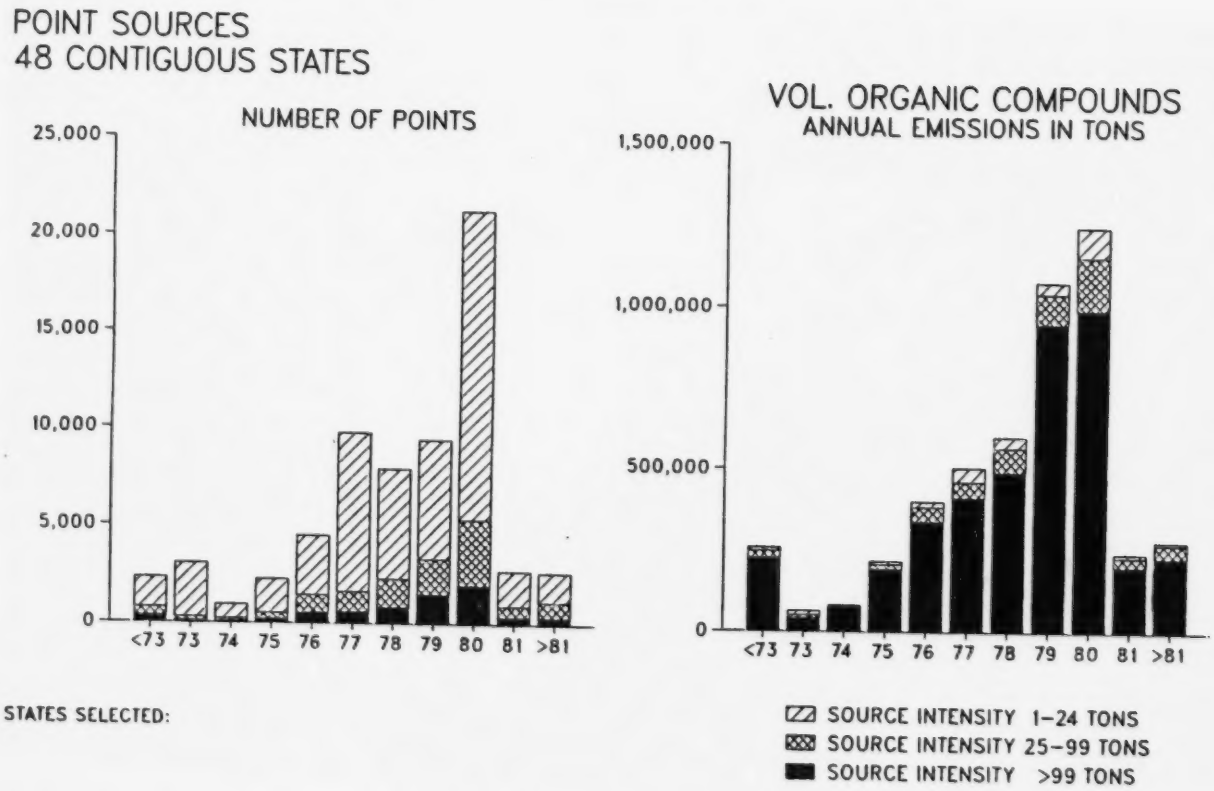

Figure 3.3 Number of Points and Emissions with Respect to Year of Record (Preliminary Data)

illustrate that sources emitting less than 100 tons per year contribute little to total SO_2 and NO_x emissions. Since the review process focused on emitters of SO_2 and NO_x, the distribution of VOC emissions, as illustrated by Figure 3.3, is not quite as narrow.

These results show that for SO_2 and NO_x, NAPAP emissions estimates are well representative of 1980. Over 80% of total emissions of these pollutants have an indicated year of record of 1980. About 95% of total emissions fall within the range from 1978-1981. For VOC, it is evident that for point sources the NAPAP data are not well representative of 1980 since only about one fourth of point source emissions have a 1980 year of record. Total VOC emissions are much more representative of 1980, however, since the majority of VOC emissions are from area sources and all area source data in NAPAP are representative of 1980. Thus, over 80% of total VOC emissions are representative of 1980, and over 90% are within the range from 1978-1981. Future NAPAP quality assurance efforts will focus on major emission points with year of record not equal to 1980 in order to try to improve the timeliness of NAPAP data.

A year of record distribution for plant, point, and process level data for NAPAP point sources is shown as Appendix A. This is not particularly useful in evaluating the year of record of emissions estimates, but may be informative to users interested in the year of record of other data elements stored in NAPAP. Appendix A shows that the modal year of record for point and process data is 1980, but that a considerable number of records have a year of record between 1977 and 1979. This does not necessarily indicate a problem since all point and process level data would not be expected to change on an annual basis. Data last updated for stack parameters in 1977 may still be valid for 1980 for example. Plant level data are evenly distributed over many years. This is to be expected since plant level data (plant name, address) are likely to change only occasionally. Plant level data are totally irrelevant to emissions estimates.

COMPLETENESS OF PLANTS REPRESENTED IN NAPAP

As a result of the extensive cross-checking that has been performed on fossil fuel-fired electric utility plants and primary copper smelters, it is certain that virtually all of these plants are included in the NAPAP point source file. The only plants that might be missing are small electric utility plants used only for peak load generation or as standby units. Because of the infrequent use of these plants, their emissions are likely to be small. Similarly, for other major industrial categories such as petroleum refineries, iron and steel mills, cement plants, etc., the completeness of the NAPAP point source file should be virtually 100%. Since these source categories have not been cross-checked with other information sources, there could be a few isolated instances where major emitting plants are missing.

Overall, the point source emissions of SO_2 and NO_x tend to be dominated by a relatively small number of very large sources as shown in

Tables 3.1 and 3.2. Most of these very large plants are electric utilities and primary smelters. The plants most likely to be missing from NAPAP emit less than 100 tons per year. For SO_2 and NO_x any such missing plants probably have a negligible impact on total emissions. The only instance in which such plants would be significant would be if there were large concentrations of small plants in a particular area that have not been included in NAPAP.

For VOC, the impact of small plants on total emissions is more likely to be significant. There are relatively few extremely large VOC sources as shown in Table 3.3. More of the total emissions are likely to come from small and medium sized sources. As a result of the extensive effort undertaken in the NECRMP project, the completeness of VOC sources in the northeastern U.S. is likely to be much better than for the rest of the country. Outside of the NECRMP domain, the completeness of the NAPAP file for VOC sources is dependent upon the completeness of the original NEDS data input to NAPAP. This is likely to be inconsistent, as some state and local agencies have done a more thorough job of reporting VOC sources to NEDS than others.

COMPLETENESS OF FUEL USE DATA

Because fuel usage is an important factor in determining SO_2 and NO_x emissions, fuel consumption summarized from the NAPAP inventory has been compared to 1980 fuel delivery data published in the State Energy Data Report (SEDR) by DOE (Reference 1). Separate tables for the electric utility sector, the industrial sector, and the commercial sector are shown in Appendix B. Each table is broken down by state for five main types of fuels. In addition, there is a graph showing the distribution of each fuel among the various end use sectors. Table 3.4 contains a summary of the NAPAP/SEDR fuel comparison in Appendix B.

The fuel comparison summary in Table 3.4 shows reasonable agreement. For bituminous coal and lignite, the NAPAP total is higher by 5.7%. The electric utility sector shows the best agreement with NAPAP being 4.5% higher. The industrial and commercial categories do not agree quite as closely but consume much less coal and are therefore less significant. For natural gas, the NAPAP total is higher by about 16% primarily due to the difference in the industrial sector. The utility and commercial sector natural gas values compare well. NAPAP fuel oil values are higher for each sector; the overall difference is a little less than 14%. The fuel oil value for each of the three sectors is higher in NAPAP by about the same percentage.

Coal use values in Table B.1 for electric utilities show the best agreement for any sector. The values are identical in a number of cases and vary in small amounts in most others. The values for gas are also in close agreement. For fuel oil, agreement is usually good, although there is more variation on a nationwide basis than for coal and gas. In general, NAPAP values exceed the fuel delivery amounts reported in SEDR.

TABLE 3.1

NAPAP POINT SOURCE EMISSIONS OF SO_2 (PRELIMINARY DATA)

Size Range (tons/year)	No. of Plants	Cumulative No. of Plants	Cumulative Percent of Total Emissions
10,000 +	430	430	79.0
5,000 - 9,999	279	709	86.8
2,500 - 4,999	338	1,047	91.6
1,000 - 2,499	632	1,679	95.6
500 - 999	610	2,289	97.3
250 - 499	778	3,067	98.4
100 - 249	1,319	4,386	99.3
1 - 99	12,577	16,963	100.0
All Plants	50,244	50,244	100.0

Size Range (tons/year)	No. of Emission Points	Cumulative No. of Emission Points	Cumulative Percent of Total Emissions
10,000 +	519	519	63.4
5,000 - 9,999	371	890	73.9
2,500 - 4,999	513	1,403	81.1
1,000 - 2,499	1,262	2,665	89.0
500 - 999	1,417	4,082	92.9
250 - 499	2,019	6,101	95.8
100 - 249	3,506	9,607	98.1
1 - 99	39,173	48,780	100.0
All Points	201,131	201,131	100.0

TABLE 3.2

NAPAP POINT SOURCE EMISSIONS OF NO_x (PRELIMINARY DATA)

Size Range (tons/year)	No. of Plants	Cumulative No. of Plants	Cumulative Percent of Total Emissions
10,000 +	256	256	58.6
5,000 - 9,999	222	478	72.2
2,500 - 4,999	297	775	81.3
1,000 - 2,499	595	1,370	89.4
500 - 999	625	1,995	93.2
250 - 499	911	2,906	96.0
100 - 249	1,483	4,389	98.0
1 - 99	14,380	18,769	100.0
All Plants	50,244	50,244	100.0

Size Range (tons/year)	No. of Emission Points	Cumulative No. of Emission Points	Cumulative Percent of Total Emissions
10,000 +	215	215	35.1
5,000 - 9,999	277	492	51.7
2,500 - 4,999	437	929	65.0
1,000 - 2,499	855	1,784	76.6
500 - 999	1,148	2,932	83.5
250 - 499	1,907	4,839	89.3
100 - 249	3,790	8,629	94.5
1 - 99	47,339	55,968	100.0
All Points	201,131	201,131	100.0

TABLE 3.3

NAPAP POINT SOURCE EMISSIONS OF VOC (PRELIMINARY DATA)

Size Range (tons/year)	No. of Plants	Cumulative No. of Plants	Cumulative Percent of Total Emissions
10,000 +	62	62	22.6
5,000 - 9,999	122	184	39.9
2,500 - 4,999	210	394	55.0
1,000 - 2,499	498	892	70.5
500 - 999	683	1,575	80.1
250 - 499	1,084	2,659	87.8
100 - 249	2,109	4,768	94.5
1 - 99	16,127	20,895	100.0
All Plants	50,244	50,244	100.0

Size Range (tons/year)	No. of Emission Points	Cumulative No. of Emission Points	Cumulative Percent of Total Emissions
10,000 +	25	25	8.9
5,000 - 9,999	85	110	20.7
2,500 - 4,999	164	274	31.9
1,000 - 2,499	591	865	50.0
500 - 999	825	1,690	61.5
250 - 499	1,537	3,227	72.4
100 - 249	3,544	6,771	83.4
1 - 99	66,655	73,426	100.0
All Points	201,131	201,131	100.0

TABLE 3.4

SUMMARY OF NAPAP/SEDR FUEL COMPARISON (PRELIMINARY DATA)

	Electric Utility Sector		Industrial Sector		Commercial Sector	
	SEDR	NAPAP	SEDR	NAPAP	SEDR	NAPAP
Anthracite Coal (10^3 tons)	951	788	1,189	677	612	1,115
Bituminous Coal and Lignite (10^3 tons)	568,045	592,636	59,161	68,645	3,203	4,987
Natural Gas (10^9 ft^3)	3,652	3,891	8,102	10,157	2,594	2,564
Distillate and Residual Fuel (10^3 barrels)	408,196	472,525	437,190	497,101	177,706	194,015

For the industrial sector (Table B.2), fuel oil amounts compare as well as for the electric utility sector but the coal and gas quantities do not. In theory, the NEDS 1980 "snapshot" inventory for point and area sources reflects the same fuel usage as the 1980 SEDR. This is due to the technique used in NEDS for determining area source fuel use. Fuel deliveries reported by DOE for the industrial sector in each state are used as a control total. Fuel usage for industrial point sources in NEDS is determined for each state and subtracted from the DOE total to obtain area source fuel use. The differences shown in Appendix B exist partly because other NEDS and NECRMP point source data have been substituted without altering the area source fuel usage. Also, when the fuel balance is made, the NEDS point source fuel usage for some states may exceed the DOE total resulting in no area source fuel consumption. No downward adjustment in NEDS point source fuel usage is made for consistency with the DOE total. Another probable difference is that the SEDR amounts include fuel deliveries for all purposes, not just fuel combustion in boilers, turbines, internal combustion engines, etc. SEDR amounts include feedstocks, but the proportion for such uses is not identified. In NAPAP, feedstock uses of fuel are normally not shown in the inventory or at least are not classified as fuel consumption. For coal use, SEDR values were adjusted to exclude coal consumed for coke production (as obtained from Reference 2) to be consistent with NAPAP. The coal values do not vary greatly except for Michigan where the NAPAP value is about twice the SEDR quantity. For natural gas, SEDR and NAPAP are in reasonable agreement except for California and Ohio. These are probably due to anomalous data values in NAPAP, which need further investigation to correct. For oil use, overall agreement is good but California and Louisiana values are significantly higher in NAPAP. In general, NAPAP values are somewhat higher for all fuels than SEDR.

For the commercial sector (Table B.3), overall agreement between SEDR and NAPAP for natural gas and fuel oil is reasonable. High coal values in NAPAP for Indiana, New York, and Ohio cause the national total to exceed the SEDR total. NAPAP values for coal and fuel oil are generally higher than SEDR. This is probably due mostly to the age of the NAPAP data, some of which still represents years prior to 1980.

In summary, differences between NAPAP and the SEDR result for several reasons. The original NEDS fuel balance has been altered by making point source but no corresponding area source modifications. Feedstock fuel is included in the SEDR for the industrial category. It appears that both fuels (distillate versus residual oil) and user categories may be incorrectly classified in NAPAP. Also, some of the fuel data in NAPAP does not represent 1980 conditions. Further investigations into the largest fuel discrepancies are planned along with some adjustment for the area source inventory as needed.

The impact on emissions of these discrepancies in fuel use is significant, but does not appear to be a major problem. Discrepancies in emissions are smaller than the discrepancies in fuel use. The problem is most apparent in the emissions for the non-utility combustion category. From Table 3.7 it can be seen that the SO_2 and NO_x emissions in NAPAP are 25-30% higher

than OAQPS emissions trends values. If all of this discrepancy were assumed to be attributable to errors in fuel use, the effect on total emissions is that NAPAP would be less than 3% higher than the OAQPS trends values. It is difficult to determine exactly how much of the difference is due to differences in fuel use and how much is due to other factors, such as differences in emission factors, fuel sulfur content, control efficiencies and the inherent imprecision of the emission estimating methodologies. For the non-utility combustion category, it is likely that discrepancies in fuel use are responsible for a major portion of the discrepancy in emissions. For the electric utility sector, differences in fuel use could also be responsible for differences in NO_x and VOC emissions. For utilities, however, the differences in fuel use are fairly minor as the result of quality assurance work that has been completed. Most of the differences in emissions, particularly for NO_x from utilities, are more likely to be due to differences in emission factors and methodology.

COMPLETENESS AND VALIDITY OF POINT SOURCE STACK DATA AND COORDINATES

Because of the importance of emission release height and plume rise in modeling, a test was applied to NAPAP stack data to judge its quality in terms of completeness. Sources had to fulfill one of the following conditions:

- Stack height, diameter, exhaust temperature, and flow rate (or velocity) values had to be present or
- A plume height value had to be present.

A plume height is used for fugitive sources that do not vent through a stack. If the source failed both conditions, it was judged to have incomplete stack data. Of course, more detailed tests can be performed once the missing or invalid data are updated.

The results of the test are presented in Appendix C. About 25-30% of the points with emissions greater than zero had incomplete stack data. However, the number of 100-ton-per-year sources with incomplete data was only 2-5% of all non-zero emitters. The contribution from sources with incomplete data and emissions of less than 100 tons per year is insignificant. This shows that to reduce the amount of emissions associated with incomplete stack data by 10-35%, only about 2-5% of the sources must be reviewed. Appendix C also includes a figure showing the states that have a high percentage of missing stack data for sources emitting over 100 tons per year of SO_2.

A similar test was performed on the location coordinates (UTM zone, easting, and northing), except that further testing was done using a range of acceptable values for each state. The results are presented in Appendix D. The situation is similar to stack data in that to get a substantial improvement in the amount of emissions associated with complete data, only a small percentage of the total number of sources must be reviewed.

It should be pointed out that, for sources failing the test, a coordinate representing the county centroid in latitude/longitude is usually available.

ASSESSMENT OF THE UNCERTAINTY IN EMISSIONS ESTIMATES

As previously stated, determination of the accuracy of emission inventory data cannot readily be determined due to the absence of true emission values against which calculated emission inventory data values could be compared. The closest thing to true emission values that are available are continuous emission monitoring (CEM) results. CEM data are not available to a great extent, but some data, particularly for the electric utility sector, are available and could possibly be used to improve the accuracy of NAPAP. At least these data would provide a much better temporal resolution of emissions for the specific plants that have CEM equipment installed. It would be desirable to acquire existing CEM data for use in NAPAP.

An evaluation of the uncertainty, or imprecision, of emission estimates in NAPAP is practical. Brookhaven National Laboratory has developed a draft report (Reference 3) with a proposed procedure for analyzing the uncertainty of the NAPAP emissions inventory. The approach relies upon statistical formulas, based on probability theory, to evaluate the propagation of errors in emission inventory calculations. Full-scale implementation of this procedure in FY 85 is contingent upon availability of funds.

COMPARISON OF NAPAP DATA WITH OTHER REFERENCES

In the absence of a more formal procedure for evaluating the uncertainty of the NAPAP inventory at present, another approach is to compare NAPAP results against other published emissions estimates to determine if the NAPAP data appear to be reasonable. Published reports that have been widely circulated include the OAQPS emissions trends report (Reference 4) and the U.S.-Canada Work Group 3B report (Reference 5). NAPAP emissions estimates are compared with data from these references in Tables 3.5 through 3.7.

Work Group 3B

The Work Group 3B inventory largely reflects a "top-down" approach. In this approach, emissions estimates are developed based on published references for fuel use, industrial production, and other source activity levels that are usually reported at the state level or are apportioned to the state level from national level data. These data are used with national or state average estimates of average emission factors, fuel sulfur contents, and control efficiencies to calculate emissions. The advantages of this approach are that it is comprehensive (i.e., the total emissions from all sources in a particular source category are easily accounted for) and not resource intensive. The latter advantage was the overriding concern for the Work Group 3B inventory which had to be developed in an extremely short time frame. The disadvantages of this approach are that detailed

TABLE 3.5

COMPARISON OF NAPAP AND WG3B SO_2 EMISSIONS ESTIMATES FOR 1980[a] (PRELIMINARY DATA)
(10^3 TONS/YEAR)

State	Electric Utilities		Non-Utility Combustion		Non-Ferrous Smelters		Transportation		Other Sources		State Total	
	WG3B	NAPAP	WG3B	NAPAP	WG3B	NAPAP	WG3B	NAPAP	WG3B	NAPAP	WG3B	NAPAP
Alabama	543	544	86	200	2	0	14	17	114	89	759	850
Arizona	88	87	9	14	732[b]	668	9	9	22	66	860	844
Arkansas	27	27	32	27	14	0	10	10	19	25	102	89
California	78	78	56	158	0	0	100	104	212	194	446	534
Colorado	78	77	24	28	0	0	10	11	20	18	132	134
Connecticut	32	32	35	31	0	0	5	5	0	1	72	69
Delaware	52	52	26	41	0	0	2	2	29	32	109	127
Dist. of Col.	5	6	8	9	0	0	1	1	1	1	15	17
Florida	726	727	97	133	0	1	43	44	229	297	1,095	1,202
Georgia	737	737	44	78	0	0	21	23	38	39	840	877
Idaho	0	0	11	19	19	19	4	4	13	14	47	56
Illinois	1,126	1,128	188	177	0	0	32	31	125	123	1,471	1,459
Indiana	1,540	1,540	290	240	5	0	22	21	151	79	2,008	1,880
Iowa	231	236	57	77	0	0	12	12	29	65	329	390
Kansas	150	150	11	27	0	0	15	14	47	40	223	231
Kentucky	1,008	1,009	66	63	7	0	14	16	26	70	1,121	1,158
Louisiana	25	25	76	252	6	21	31	36	166	167	304	501
Maine	16	16	65	98	0	0	4	3	10	17	95	134
Maryland	223	223	56	36	6	0	15	15	38	22	338	296
Massachusetts	276	276	58	74	0	0	9	10	1	2	344	362
Michigan	565	563	154	161	53[b]	53	20	19	96	82	888	878
Minnesota	177	178	44	44	0	0	14	15	25	26	260	263
Mississippi	129	129	48	70	0	0	18	26	90	81	285	306
Missouri	1,141	1,140	55	82	30	31	19	16	56	28	1,301	1,297
Montana	23	23	25	26	86	77	6	6	24	37	164	168
Nebraska	50	50	4	7	0	0	10	8	11	12	75	77
Nevada	34	39	2	5	95[b]	95	3	4	4	4	138	147
New Hampshire	80	81	10	23	0	0	2	2	1	1	93	107
New Jersey	110	110	75	109	0	0	25	28	69	56	279	303
New Mexico	85	85	2	6	63	83	10	7	109	77	269	258
New York	480	479	335	305	6	0	38	37	85	43	944	864
North Carolina	435	435	116	155	1	0	18	16	32	47	602	653
North Dakota	86	83	13	19	0	0	5	5	3	7	107	114
Ohio	2,172	2,173	311	389	7	1	35	39	122	103	2,647	2,705
Oklahoma	38	38	15	24	0	0	13	3	55	37	121	102
Oregon	3	3	25	28	4	0	15	13	13	12	60	56
Pennsylvania	1,466	1,466	254	238	3	3	37	35	262	110	2,022	1,852
Rhode Island	5	5	8	7	0	0	2	1	0	1	15	14
South Carolina	213	213	84	91	0	0	10	9	19	29	326	342
South Dakota	29	29	3	5	0	0	4	3	3	4	39	41
Tennessee	934	934	83	132	6	0	17	17	37	51	1,077	1,134
Texas	303	303	107	305	87	53	96	95	684	585	1,277	1,341
Utah	22	22	16	37	4	5	6	7	24	45	72	116
Vermont	1	0	5	6	0	0	1	3	0	1	7	10
Virginia	164	161	142	158	0	0	25	21	30	46	361	386
Washington	69	69	41	65	107	114	21	19	34	59	272	326
West Virginia	944	944	84	99	9	0	7	7	44	54	1,088	1,104
Wisconsin	486	479	107	157	0	0	15	13	30	39	638	688
Wyoming	118	121	30	49	0	0	7	9	29	70	184	249
Total	17,323	17,324	3,493	4,584	1,352	1,224	872	871	3,281	3,108	26,321	27,111

[a] Categories defined in WG3B report. NAPAP values categorized based on first SCC encountered for each emission point.

[b] Emissions in WG3B summary Table B.2.1 adjusted to reflect more accurate values for copper smelters in Table C.2.3.

TABLE 3.6

COMPARISON OF NAPAP AND WG3B NO_x EMISSIONS ESTIMATES FOR 1980[a] (PRELIMINARY DATA)
(10^3 TONS/YEAR)

State	Electric Utilities		Non-Utility Combustion		Non-Ferrous Smelters		Transportation		Other Sources		State Total	
	WG3B	NAPAP	WG3B	NAPAP	WG3B	NAPAP	WG3B	NAPAP	WG3B	NAPAP	WG3B	NAPAP
Alabama	172	206	83	106	0	0	164	184	31	29	450	525
Arizona	91	120	40	32	0	1	119	120	8	21	258	294
Arkansas	26	49	45	50	0	0	131	126	15	7	217	232
California	115	185	205	246	0	0	820	743	85	149	1,225	1,323
Colorado	86	105	67	51	0	0	115	124	9	12	277	292
Connecticut	20	27	23	27	0	0	90	88	1	2	134	144
Delaware	19	28	9	13	0	0	22	26	2	2	52	69
Dist. of Col.	1	2	6	5	0	0	14	19	1	1	22	27
Florida	214	236	52	23	0	0	347	356	35	14	648	629
Georgia	189	230	39	78	0	0	236	253	30	26	494	587
Idaho	0	0	14	11	0	0	52	54	15	26	81	91
Illinois	416	542	129	132	0	0	425	400	35	43	1,005	1,117
Indiana	361	432	99	113	0	0	280	276	33	39	773	860
Iowa	98	133	47	47	0	0	166	160	10	9	321	349
Kansas	86	176	151	237	0	0	176	160	24	19	437	592
Kentucky	272	328	67	50	0	0	183	200	9	26	531	604
Louisiana	98	185	552	346	0	0	190	193	89	97	929	821
Maine	1	4	13	20	0	0	42	38	3	2	59	64
Maryland	61	78	37	51	0	0	143	142	7	7	248	278
Massachusetts	57	68	37	18	0	0	158	156	2	30	254	272
Michigan	238	270	121	144	0	0	302	300	29	32	690	746
Minnesota	112	200	53	51	0	0	201	196	8	9	374	456
Mississippi	50	59	79	93	0	0	125	120	31	23	285	295
Missouri	237	302	50	45	0	0	254	231	27	29	568	607
Montana	23	14	22	18	0	0	63	66	18	32	126	130
Nebraska	40	77	22	26	0	0	124	101	9	6	195	210
Nevada	43	74	4	4	0	0	35	43	1	2	83	123
New Hampshire	24	26	4	6	0	0	27	27	1	1	56	60
New Jersey	66	99	68	77	0	0	246	235	26	23	406	434
New Mexico	80	132	109	93	0	0	97	77	4	5	290	307
New York	130	187	139	175	0	0	385	371	26	15	680	748
North Carolina	214	253	50	67	0	0	253	235	19	15	536	570
North Dakota	53	99	11	11	0	0	60	57	1	1	125	168
Ohio	516	534	162	196	0	0	438	457	29	32	1,145	1,219
Oklahoma	105	136	216	143	0	0	181	160	24	23	526	462
Oregon	3	4	25	50	0	0	144	148	20	26	192	228
Pennsylvania	391	490	164	140	0	0	434	407	49	45	1,038	1,082
Rhode Island	3	3	5	8	0	0	28	24	1	1	37	36
South Carolina	84	108	39	54	0	0	127	126	10	14	260	302
South Dakota	21	20	3	4	0	0	58	45	7	8	89	77
Tennessee	200	241	68	77	0	0	224	218	25	37	517	573
Texas	522	821	1,113	1,685	0	0	746	769	163	211	2,544	3,486
Utah	39	59	33	36	0	0	65	69	7	11	144	175
Vermont	1	0	2	2	0	0	22	41	0	1	25	44
Virginia	62	90	65	73	0	0	250	217	28	31	405	411
Washington	25	85	32	47	0	0	193	181	39	37	289	350
West Virginia	302	311	54	64	0	0	87	86	9	12	452	473
Wisconsin	145	147	57	72	0	0	208	193	11	14	421	426
Wyoming	102	142	78	71	0	0	69	78	6	8	255	299
Total	6,214	8,117	4,563	5,188	0	1	9,319	9,096	1,072	1,265	21,168	23,667

[a] Categories defined in WG3B report. NAPAP values categorized based on first SCC encountered for each emission point.

TABLE 3.7

COMPARISON OF NAPAP AND OAQPS EMISSIONS TRENDS
EMISSION ESTIMATES FOR 1980 (PRELIMINARY DATA)
(10^3 TONS/YEAR)

Category	SO_2		NO_x		VOC	
	Trends	NAPAP	Trends	NAPAP	Trends	NAPAP
Electric Utilities	17,090	17,324	7,084	8,117	46	71
Non-Utility Combustion	3,572	4,584	4,068	5,188	1,933	1,062
Non-Ferrous Smelters	1,332	1,224	0	1	0	0
Transportation	1,006	871	10,500	9,096	7,299	7,965
Other Sources	2,695	3,108	1,112	1,265	13,705	14,171
Total	25,695	27,111	22,764	23,667	22,983	23,269

plant level data needed for modeling are not available and because of the requirement to assume national average emission factors and control levels in most instances, the probable errors in the results increase as the emissions are disaggregated to smaller geographic areas. An exception to the top-down approach in the Work Group 3B inventory was SO_2 emissions for electric utilities which were developed from plant-specific data by E.H. Pechan and Associates.

The Work Group 3B data were based to a great extent on NEDS summary data which were not as representative of 1980 conditions as the NEDS inventory used for NAPAP. Both NAPAP and Work Group 3B used 1980 electric utility data from E.H. Pechan and Associates. Industrial combustion emissions in Work Group 3B were based on 1979/1980 state-level fuel deliveries. Average uncontrolled emission factors and sulfur contents with AP-42 emission factors were used to estimate emissions. On the other hand, NAPAP emissions were calculated from fuel consumption, fuel quality, and control equipment data supplied by individual plants for each combustion unit. Industrial process emissions in Work Group 3B were based on estimates of production rates for process groups and AP-42 emission factors supplemented by NEDS summary data. Operating and control equipment data provided by the plants for each emission point were used to estimate emissions in NAPAP. In comparing emissions from Work Group 3B and NAPAP, the simplifying assumptions and lack of detail employed in compiling the Work Group 3B data should be recognized.

Table 3.5 compares SO_2 emissions for five source categories and provides total emissions for each state. Total U.S. emissions in NAPAP are higher by 3.0%. NAPAP emissions for the nation are greater for only the non-utility combustion category. State to state differences in emissions are sometimes greater than those for the nation but none of the differences are large in terms of emissions. The percent differences in a few cases are, however, sufficiently large to warrant investigation. The footnote in the tables relates to the problem of attempting to summarize NAPAP emissions data. The only available means is to use the SCC as a retrieval and summarization technique. In cases that multiple SCCs exist for a source, emissions are assigned to the first one encountered. When the SCC is not correct, emissions are assigned to an incorrect category.

Table 3.6 compares NAPAP and Work Group 3B NO_x emissions. Total U.S. emissions in NAPAP are higher by 11.8%. NAPAP emissions for the nation are less for only the transportation category. As was the case for SO_2, state-to-state differences are sometimes larger than on a national basis but the differences are not great in terms of emissions with the exception of Texas. The percent differences are in a few cases large enough to warrant investigation. However, the differences are not of the same magnitude and sign as for SO_2 nor do they necessarily occur in the same instances.

OAQPS Emissions Trends

NAPAP emission estimates are compared with OAQPS emissions trends estimates for 1980 in Table 3.7. Since the OAQPS trends report gives only national emissions, only national totals can be compared. The OAQPS trends

data also includes Alaska and Hawaii, but these states have a small impact on national emissions. The NAPAP SO_2 emission estimates are 5.5% higher than the OAQPS emissions trends estimates. NAPAP estimates of SO_2 from non-utility combustion and other sources are high compared to OAQPS trends values. Note that there is close agreement between OAQPS trends and Work Group 3B data for these categories. This suggests that there may still be some problems with the NAPAP data that require investigation, although both the OAQPS trends and Work Group 3B inventories reflect a "top-down" approach and used similar methodologies. For the non-utility sector, additional refinement of the NAPAP data are needed. For the utility sector, emissions agree very closely. The trends estimate is about 1.4% lower than NAPAP. For other source categories, emissions of SO_2 generally agree within $\pm$ 10%. Considering the relatively small contribution to total emissions from these sources, this difference is not seen as a serious problem.

For NO_x, NAPAP is 4.0% higher than the OAQPS emission trends, a very good overall agreement. Emissions estimates for electric utilities and transportation sources are not in close agreement, however. When added together, differences in emissions cancel each other out so that total emissions are close. For electric utilities, there is enough uncertainty associated with the NO_x estimates to cause doubt about which estimate is the best. Both NAPAP and Work Group 3B differ from the OAQPS trends estimate by 10-15%. Considering the relative importance of this source category to total NO_x emissions, greater confidence is needed. Hopefully, NO_x emissions estimates from E.H. Pechan and Associates should be available soon and should be helpful in resolving discrepancies between existing data bases. For non-utility combustion sources, NAPAP is higher than trends and Work Group 3B. The Work Group 3B estimates do not agree as closely with trends estimates for NO_x as they do for SO_2. Both NAPAP and Work Group 3B differ from trends due most likely to discrepancies in fuel use and differences in emission factors and control device efficiencies. For transportation sources, the NAPAP and Work Group 3B estimates are close. However, both are lower than the OAQPS trends estimate. The OAQPS trends estimate is based on up-to-date emission factors and refined estimates of vehicle miles traveled (VMT). The OAQPS trends estimate may overestimate emissions slightly, but is probably a more accurate estimate of national emissions than either NAPAP or Work Group 3B. The Work Group 3B data are based on outdated emission factors and inadequate VMT data. The NAPAP data have updated emission factors but still lack adequate VMT. More detailed estimates of VMT by vehicle classification by road speed category are needed to improve NAPAP. Unfortunately, such data are known to be available for only a very few areas. Until more VMT data can be obtained, or the basic NEDS procedure that NAPAP relies upon for calculation of emissions is modified to better compensate for the lack of adequate VMT data, the NAPAP emission estimates will continue to be deficient.

For VOC, NAPAP and OAQPS emissions trends total emissions agree very closely. For the non-utility combustion and transportation sectors, some differences are apparent, however. NAPAP emissions for transportation are somewhat higher than OAQPS trends estimates, primarily because of differences in highway vehicle emissions. These differences are caused by the lack of adequate VMT data for individual counties, as described earlier

for NO_x emissions. For non-utility combustion, the difference in emissions relates primarily to the residential combustion of wood. The data contained in NAPAP are based on 1980 NEDS data. For 1981, NEDS data were revised to consider more recent estimates of the amount of wood burned (Reference 6) and the latest available emission factors (Reference 7). The OAQPS trends report is consistent with these most current references. However, NAPAP still contains 1980 NEDS data which yield substantially lower estimates of VOC emissions from residential wood combustion (13×10^3 tons/year in 1980 NEDS versus $1,760 \times 10^3$ tons/year from OAQPS trends report).

NECRMP and NEDS

The NAPAP data may also be compared with NECRMP and NEDS inventories for 1980. The main purpose in doing this comparison would be to verify that the original NEDS and NECRMP data loaded into NAPAP were successfully converted. This process is described in more detail in Chapter 4. Since the current NAPAP inventory has had other changes made to it since conversion and emission factors used in NAPAP may not be the same as those used in the NECRMP, it should not be expected that NAPAP point source data would agree with the original NEDS and NECRMP data that were used. Nevertheless, it may be of interest to compare, for the purpose of frame of reference, the NAPAP, NEDS, and NECRMP data for the appropriate source categories, pollutants, and states. These comparisons are shown in Tables 3.8 and 3.10.

A comparison of NAPAP and NECRMP area source emissions may be of more interest. This result is shown in Table 3.9. A future action item for NAPAP is to consider substituting NECRMP area source data into NAPAP to go with the NECRMP point source data that have already been substituted. As shown in Table 3.9, NO_x area source estimates are usually very similar. The largest discrepancies occur in Massachusetts, New Jersey, and New York. For VOC, NAPAP data are consistently higher than NECRMP. This can be attributed mainly to the NEDS area source organic solvent emissions that have been loaded into NAPAP. The methodology used for NEDS in 1980 probably overestimates area source organic solvent emissions. If these data were adjusted to be consistent with the current NEDS area source methodology, there should be closer agreement between NECRMP and NAPAP.

Other Inventories

Other previously compiled and widely used emission inventories include the Sulfate Regional Experiment (SURE) and the Multi-State Atmospheric Power Production Pollution Study (MAP3S). A comparison of these inventories with NAPAP data is not appropriate, however. Both of these data bases were compiled in earlier years using emission factors and inventory procedures that are now obsolete. Also, neither of these inventories represent a 1980 base year, so comparison to 1980 NAPAP data would not be appropriate. Work Group 3B included preliminary estimates of VOC emissions but these have not been compared with NAPAP data. The Work Group 3B VOC estimates, being preliminary in nature, used preliminary estimates of 1980 VMT and emission factors. As a result, these data are not as good as the final 1980 NEDS

TABLE 3.8

COMPARISON OF NAPAP AND NECRMP NON-UTILITY POINT SOURCE NO_x AND VOC EMISSIONS[a] (PRELIMINARY DATA) (10^3 TONS/YEAR)

State	NO_x		VOC	
	NECRMP[b]	NAPAP	NECRMP[b]	NAPAP
Connecticut	18	14	34	44
Delaware	8	8	21	26
District of Columbia	3	3	2	1
Maryland	46	36	77	76
Massachusetts	46	20	112	107
New Hampshire	4	4	20	20
New Jersey	97	61	156	153
New York	177	134	171	142
Pennsylvania	161	105	258	238
Rhode Island	2	3	13	13
Vermont	1	1	5	4
Totals	563	389	869	824

a Reflects only the states wholly included in the NECRMP study area.

b Assumes non-utility point source emissions represent all NECRMP source categories except utility boilers. NECRMP does not report specific emissions for any electric utility internal combustion engines, so any emissions from such sources are included in the non-utility category. This may cause cited NECRMP value to be overestimated in some cases.

TABLE 3.9

COMPARISON OF NAPAP AND NECRMP AREA SOURCE NO_x AND VOC EMISSIONS[a] (PRELIMINARY DATA) (10^3 TONS/YEAR)

State	NO_x		VOC	
	NECRMP[b]	NAPAP	NECRMP[b]	NAPAP
Connecticut	113	103	168	259
Delaware	41	33	36	48
District of Columbia	16	22	21	43
Maryland	157	164	198	270
Massachusetts	266	184	236	444
New Hampshire	45	30	59	69
New Jersey	349	274	415	562
New York	587	427	652	988
Pennsylvania	491	487	466	802
Rhode Island	49	30	49	84
Vermont	26	43	34	36
Totals	2,140	1,797	2,334	3,605

a Reflects only the states wholly included in the NECRMP study area.
b Reference 8.

TABLE 3.10

COMPARISON OF NAPAP AND 1980 NEDS EMISSIONS
OF SO_2, NO_x, AND VOC (PRELIMINARY DATA)
(10^3 TONS/YEAR)

	SO_2		NO_x		VOC	
	NEDS[a]	NAPAP	NEDS[a]	NAPAP	NEDS[a]	NAPAP
Point Sources						
Electric Utilities	17,676	17,324	8,041	8,117	89	71
Non-Utility Combustion	3,540	3,371	2,607	2,497	200	289
Other	5,264	4,306	852	952	5,289	4,602
Subtotal Point Source	26,480	25,001	11,500	11,566	5,578	4,962
Area Sources						
Non-Utility Combustion	1,215	1,213	2,662	2,691	760	773
Transportation	901	871	9,262	9,096	8,188	7,965
Other	27	26	316	314	9,597	9,569
Subtotal Area Source	2,143	2,110	12,240	12,101	18,545	18,307
Total All Sources	28,623	27,111	23,740	23,667	24,123	23,269

[a] Reference 9. NEDS totals have been adjusted to exclude Alaska, Hawaii, Puerto Rico, Guam and the Virgin Islands so that both NEDS and NAPAP represent the same geographic area.

estimates of area source emissions upon which the NAPAP data are based, and therefore no comparison is appropriate.

CONCLUSION

Many improvements have been made to the NAPAP inventory since the initial creation of the file in 1983. The current Version 3.0 of NAPAP represents the best available detailed inventory compiled to date on a nationwide scale. Still more improvements would be desirable. Chapter 5 discusses plans for addressing some of these. The additional efforts planned for the remainder of FY 84 should be successful in eliminating some of the more obvious problems with the NAPAP inventory. Resource limitations will prevent all potential problems from being adequately investigated and resolved, however.

NAPAP has benefited from previous inventory efforts such as the U.S.-Canada Work Group 3B study, NECRMP, and E.H. Pechan analyses of electric utility data. Results of these studies have been incorporated into NAPAP. Future NAPAP quality assurance activities will focus on eliminating or minimizing remaining data gaps or inconsistencies. Efforts will be directed toward a review of the largest emitting sources to obtain correct and timely emissions estimates, fuel use data, stack data, and grid coordinates.

For area sources, little quality assurance work has been done so far. Resolution of NAPAP and NECRMP area source emission differences and modification of data for residential wood use, highway vehicles, and organic solvent use to be compatible with current NEDS methodology would be desirable.

Version 3.0 of NAPAP should be adequate to meet many user's needs for both summary and detailed emissions data. By far the greatest challenge remaining is to upgrade the NAPAP inventory to meet Eulerian modeling requirements. The addition of more pollutants, development of finer spatial and temporal allocation procedures, and associated data processing and quality assurance activities required for each of these tasks are major concerns. These activities may prove to be very cumbersome and costly. Completion of these activities is of very high priority for the remainder of FY 84 and FY 85, but is contingent upon the availability of adequate funds.

CHAPTER 3

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CHAPTER 4

HISTORY OF THE DEVELOPMENT OF THE NAPAP EMISSION INVENTORY

INTRODUCTION

Activities by ES to create the initial detailed NAPAP emission inventory for base year 1980 began in January 1983. The first actions required were to convert the existing NEDS data into EIS format. Conversion of point source data was relatively straightforward and was accomplished within two months from project inception. Conversion of area source data was more difficult and required more time and resources to complete. Once the conversion of data was accomplished, various comparative assessments of the data were initiated. These assessments resulted in the completion of a number of NAPAP inventory improvements. A preliminary version, incorporating the results of the initial assessment exercise, was available in August 1983. Additional revisions were made to the data and the resulting Version 1.0 was made available to users, particularly to support testing of Lagrangian models, in November 1983. Version 2.0 was made available to users in January 1984. Version 3.0, representing the current NAPAP inventory, was completed in May 1984. The activities performed to create Version 3.0 are described in detail in the following sections.

POINT SOURCE CONVERSION

A goal of the initial conversion of the 1980 NEDS point source snapshot file to EIS/PS format (Reference 1) was to maintain equivalency between emission totals in NEDS and EIS. However, reporting differences between the two processing systems caused state emission totals to disagree in some cases by a substantial percentage.

One reporting difference involved sources under construction and sources that had ceased operation. In EIS/PS, emission estimates are reported regardless of operational status, while NEDS reports zero emissions for sources which are closed or under construction. Another reporting difference involved sources where there were insufficient data to complete an emission calculation but where an estimate had been entered by hand. In NEDS, zero emissions are reported while EIS reports the estimate entered by hand in the NEDS file. These reporting differences have not been resolved but are being investigated with EPA.

Emission differences were not totally eliminated due to the required effort in reviewing all affected sources, but efforts were made during the conversion process to minimize them. For most states and pollutants the NAPAP

and NEDS emissions were nearly identical. In some cases, the difference was 1% or more and in a few instances, the difference was as high as 15%. Because many improvements have and will continue to be made to the NAPAP data base, the significance of differences between NEDS and the original NAPAP inventory should eventually become unimportant. The NAPAP data were compared with other data sources to try to get the best available emissions estimates as previously discussed in Chapter 3.

AREA SOURCE CONVERSION

The National Emissions Data System (NEDS) served as the starting point for the development of the NAPAP area source inventory in EIS/AS format (Reference 2). The NEDS-to-EIS/AS conversion program was used to generate EIS/AS transactions from the NEDS file. Since there was no conversion program for area source emission factors, ES developed one and used it to access the NEDS area source emission factor file on the UNIVAC machine at NCC. EIS/AS emission factor transactions were produced, recorded on magnetic tape, and transferred to the IBM machine for creating the area source masterfile.

The transactions contained emission factors for area source categories in a national-state-county hierarchy; that is, if a county-level emission factor did not exist for a particular category, then a state-level or finally a national-level emission factor was included. Exceptions to this were the factors for construction and miscellaneous wind erosion which were not available at the national level. The EIS/AS emission factor insertion program had to be modified to accept this three-tier structure. It had previously been able to handle only two tiers of factors. The modified program still operates on a two-tier structure in that when county factors are not available, national-level factors are applied unless state-level factors exist.

After running a summary program to compare emission totals, it was discovered that the category "vehicle miles traveled" was blank or zero in many states. Activity levels for this category had not been provided in the NEDS area source base file. It was learned that these estimates are routinely calculated from auxiliary vehicle files when the NEDS summary program executes, but that they are not stored in the NEDS file. Therefore, ES developed a program to read the NEDS file, calculate and insert VMT where required, and to output the modified file.

After the VMT data had been inserted onto the NEDS cards, the conversion process continued and an initial version of the NAPAP EIS/AS masterfile was created. Summary printouts were obtained and county total emissions were compared to the area source summaries from NEDS supplied by NADB. Differences were found in the totals which could not be explained without obtaining more detailed information from NEDS. ES obtained NEDS county level emission data for each area source category from NADB.

After reviewing the data provided by NADB, ES was able to determine why NEDS and EIS emissions data were inconsistent. NEDS makes an internal adjustment to account for the fact that the units on the county activity

values are not equivalent to the units in the emission factor file. The emission factor file units correspond to the units used in AP-42 while the units on the data cards were defined to provide sufficient spaces to enter the activity value for each county in the country. The ratio of the units (cards/file) varies from a factor of 10 to a factor of 1000. ES was able to correct this difference by modifying the conversion program to produce the same units for the EIS activity values as used in the NEDS emission factor file.

After the EIS/AS masterfile was created, summary reports were generated and compared to the NEDS summaries. The emission totals in NEDS and NAPAP generally differ by only 1-2% on a county basis for sulfur dioxide and oxides of nitrogen. There is also good agreement between the two files for each area source category.

AUDIT TRAIL DEVELOPMENT

As a result of the improvements made to NAPAP based on data obtained from other sources, the NAPAP inventory is no longer a totally NEDS-originated file. Some means must be available for determining the source of information for the improvements. ES devised a system whereby comments of any size and nature can be carried along with each point to describe data sources and assumptions as necessary. The scheme uses a modified version of the EIS/PS file maintenance program to take advantage of EIS/PS Segment 3, a free-format field providing for up to 99 comments of 999 lines each, with each line capable of storing 102 characters. Presently, this scheme requires manual coding of transactions containing the comments to be included. It is anticipated that future improvements to the NAPAP file maintenance program will include automatic generation of audit trail comments. In addition to comments maintained in the computer file, a paper trail is being maintained to identify updates that have been made and substitutions of blocks of data from other non-NEDS sources.

Periodic reports, such as this document, are planned to keep users informed of the progress made in updating the NAPAP data files. Also, users will be routinely notified when new versions of the NAPAP inventory are available.

DATA BASE IMPROVEMENTS

In an effort to improve the quality of the NAPAP data base, updates were initiated to address areas where the NEDS inventory was known to be deficient. The updates included substitution of other NEDS data more representative of 1980, incorporation of the most recent EPA emission factors, addition of location coordinates for those sources with erroneous or missing coordinates, replacement of fuel data for major utility boilers usi 1980 Federal Power Commission (FPC) data, replacement of copper smelte ata with those from Work Group 3B, substitution of selected data with t from the Northeast Corridor Regional Modeling Project, and addition of seasonal factors to the area source inventory. The data sources used to make

NAPAP improvements, although not perfect, are believed to be the best available. The following sections give further information concerning these improvements.

Substitution of Other NEDS Data

The NEDS inventory is dynamic in that it is constantly being updated with information submitted by the states. However, because of manpower and resource limitations at the state level, not all records can be updated every year. As a result, there is a distribution of record dates spanning several years. EPA's National Air Data Branch (NADB) (North Carolina) routinely archives a "snapshot" copy of the file every year for future reference, and the snapshot file most representative of 1980 served as the source for creation of the initial NAPAP inventory. However, NEDS data more representative of 1980 were obtained for 12 states from previous snapshot files and subsequent state submittals. ES replaced the NAPAP data for entire states with these NEDS data.

Incorporation of Most Recent EPA Emission Factors

After initial creation of the NAPAP inventory, Supplement 14 to AP-42 (Reference 3) was released with new and updated emission factors for a variety of processes. Using standard EIS/PS routines, ES replaced emission factors stored in the masterfile with the new values obtained from NADB and recalculated emission estimates for sources where an estimation method of '3' indicated that computer-automated emission calculations should be performed. The Supplement 14 emission factors were applied to the supplementary NEDS data discussed in the previous section as well as to the Northeast Corridor data covered in a subsequent section of this chapter.

Addition of Location Coordinates

Because source location is a critical input to acid deposition models, a study was undertaken by EPA's Environmental Sciences Research Laboratory to improve the accuracy of NAPAP source location data. The procedure used was simply to determine if the location specified by the coordinates of a source was within the boundaries of the county specified in the source identification key. For sources with missing location data or with location data outside the county, EIS/PS transactions were prepared to substitute the location of the county centroid. ES then processed these transactions which added latitude and longitude coordinates to the masterfile and blanked out any existing UTM location data.

Power Plant Update

In the United States, the electric utility industry is responsible for approximately two-thirds of the sulfur dioxide emissions and a substantial portion of nitrogen oxide emissions. Thus, it is desirable to update power plant data in NAPAP using the best available information.

Data Sources

The power plant data of greatest concern are fuel type and quantity, fuel quality, and combustion configuration. In addition, information on any controls applied to fuel-based emissions is important. Since the power plant data in NAPAP exists on an emission point level, a detailed data base at the combustion unit level was required. To obtain the needed information, a number of data sources were used.

The majority of the information was obtained from the 1980 electric utility unit inventory compiled from FPC data by E.H. Pechan and Associates (Reference 4) under a contract to the Universities Research Group on Energy (URGE). URGE, led by the University of Illinois, was established to develop a comprehensive modeling framework to address acid deposition concerns related to the electric utility industry. The unit inventory provided data for each of the larger units in the electric utility industry. The smaller units (those with less than 25 megawatts output) were aggregated into "generic" units at the state level. The generic units were not considered for this update. There were approximately 20 data elements taken from the unit inventory to update NAPAP:

- Fuel type (primary and secondary)
- Fuel quality (ash-sulfur content, heating value)
- Fuel amount
- Combustion unit type
- TSP, SO_2, and NO_x control data
- Unit heat input capacity

Another data source used in the NAPAP update was the FPC data. Monthly fuel usages reported on FPC Form 4 by power plants (obtained from E.H. Pechan and Associates) were input to a computer program to generate a seasonal breakdown of fuel usage. These seasonal percentages were used to update annual throughput fields in NAPAP.

A third data source used in updating NAPAP was the inventory of power plants published by the U.S. Department of Energy (DOE) (Reference 5). This data source was used to cross-reference plants in NAPAP with those in the unit inventory. DOE's publication was also helpful in cross-checking the fuel and prime mover type for a given facility.

The final data source used for the update was the E.H. Pechan electric utility plant inventory (Reference 6). ES made use of the plant total 1980 SO_2 emissions reported by Pechan to update NAPAP.

Methodology

A major task in using Pechan's data was to determine a one-to-one correspondence between plants listed in the unit inventory and those contained in NAPAP. It was even more difficult to match combustion units in the unit inventory with emission points in NAPAP. The unit inventory is arranged by Federal Information Processing Service (FIPS) code whereas NAPAP uses SAROAD state and county codes. Plants are identified by plant

name in the unit inventory whereas NAPAP lists them by company name and address. Matches were made or confirmed using the DOE inventory of power plants and an EPA/NADB list of NEDS identification numbers and corresponding plant names from the unit inventory. Once a plant was matched, emission points within the plant were matched with individual combustion units on the basis of unit design capacity, type of unit, and type of fuel being burned. The DOE publication also provided primary and secondary fuel data for each unit which was used as necessary for matching. Once a plant and the units within a plant were matched, the updating process was initiated. Fuel amount, ash and sulfur content, combustion unit capacity, source classification code, and control equipment data were updated using data in the unit inventory. Data for boiler units not matched in NAPAP were accounted for by either adding a new emission point or adding the fuel amount to similar units at the plant. Only a few plants and combustion units within a plant with relatively insignificant fuel use could not be matched.

The unit inventory also provided information about control equipment. For TSP and SO_2, the type of control equipment and control efficiency was obtained directly from the unit inventory. However, information about the effectiveness of the NO_x control equipment was not provided. The NO_x control equipment efficiency had to be determined on the basis of published data and engineering judgement. In many cases the unit inventory contained three (primary, secondary, and tertiary) types of NO_x control equipment. Only two of these were entered into NAPAP because only two data fields (primary and secondary) are available per pollutant for control equipment codes. This has no impact on emissions because control efficiency is still specified in NAPAP. Tertiary control equipment cannot be indicated, however, due to the limitation of the EIS/PS system design.

To determine seasonal throughput, monthly fuel use data contained on FPC Form 4 were aggregated into seasonal and annual totals and the percentages by season were calculated. Form 4 data are reported by fuel type and prime mover type for each plant. Since combustion unit-specific information was not available, the same seasonal breakdown was used for all emission points within a plant using the same type of fuel. When units burned multiple fuels, the relative amount of each fuel burned was considered in calculating seasonal percentages.

Because emission factors in EIS are selected on the basis of source classification code (SCC), it is important to ensure the accuracy of SCCs. The unit inventory contains information on burner type which was used as necessary to update the SCCs in the NAPAP data base. The NO_x emission factors were of special concern since burner type can affect emissions by a factor of two.

There were a number of cases in which data contained in the unit inventory appeared to be unreasonable. There were, for example, boilers burning coal with high ash content but no TSP control equipment and boilers burning fuel with unreasonably high ash or sulfur content. In cases like these, NAPAP data from the emission point, from other emission points within the same plant, or from similar plants were used for the update. Pechan and

Associates is currently in the process of revising the unit inventory, and it is presumed that any problems of this type will be eliminated.

In NAPAP, there were many emission points with emission estimation method codes of 1, 4, and 5 (source test, guess, or special non-EPA emission factor) and no indication as to how emission factors were derived and used. As a result, all estimation method codes except those for SO_2 were changed to '3' so that emission estimates would be generated by EIS using AP-42 emission factors and updated information on fuel amount and quality and control efficiency.

A few assumptions made in the NAPAP update are listed below:

- The unit inventory did not contain data on coal type; therefore, coal was assumed to be bituminous coal unless it was listed otherwise in NAPAP.

- Distillate oil identified as a primary fuel in the unit inventory was assumed to be residual oil because the oil type codes in the unit inventory were found to be inaccurate in most cases.

- Fuels listed as light oil or distillate in the unit inventory and in the DOE inventory were assumed to be #2 oil.

After the unit inventory updates were complete, ES then used the plant-level SO_2 emission estimates from the Pechan plant inventory (Reference 6) to update NAPAP. Plant total emissions were allocated to each emission point on the basis of its percentage of plant total emissions in NAPAP. The Pechan plant inventory did not provide estimates of NO_x or VOC emissions.

Work Group 3B Copper Smelter Updates

The Emissions, Costs, and Engineering Assessment Work Group 3B was established to provide engineering support for the U.S.-Canada Agreement on Transboundary Air Pollution. One of the tasks assigned to Work Group 3B was to determine 1980 emission rates from copper smelters in the U.S. Since there are only 15 such facilities in the U.S., data specific for 1980 were obtained for each smelter. The copper smelters in the NAPAP file were updated to agree with the sulfur dioxide emission rates in the Work Group 3B report (Reference 7). Updates were made to process rates and control efficiencies when possible based on the Work Group 3B data.

Substitution of NECRMP Data

As part of the Northeast Corridor Regional Modeling Project (NECRMP) (Reference 8), EPA's Office of Air Quality Planning and Standards developed an annual point source inventory in EIS/PS format using data supplied directly from the states, from NEDS, and from other supplemental data bases. The NECRMP area includes all, or portions of, the following states:

- Connecticut
- Delaware
- Maine (portion)
- Maryland
- Massachusetts
- New Hampshire
- New Jersey
- New York
- Ohio (portion)
- Pennsylvania
- Rhode Island
- Vermont
- Virginia (portion)
- Washington, D.C.
- West Virginia (portion)

Because of the quality assurance (QA) efforts that were included in the NECRMP point source development and because the NECRMP data represent a 1980 time period, the NECRMP data for NO_x and VOC is generally considered to be of better quality than the original NAPAP data. All of the NECRMP data, with two exceptions discussed below, were used to replace the corresponding NAPAP data.

NECRMP data for utility combustion units greater than 25 megawatts were not substituted into the NAPAP inventory. Data for those units were obtained from the unit inventory discussed in a previous section. Thus, NECRMP data were used only for those power plants that do not have any combustion units exceeding 25 megawatts in capacity.

Since the NECRMP inventory was to be used for photochemical oxidant modeling, QA checks focused primarily on sources of VOC and NO_x. ES performed a limited QA review of SO_2 data by comparing the NECRMP data with the corresponding data in the NAPAP inventory. The important parameters that were reviewed included:

- SO_2 emission rate
- Emission estimation method
- Year of record
- Fuel-process rate
- Emission factor

The ES review included each emission point with more than 0.1% of the total SO_2 emissions in the NECRMP area. There were 315 points in the NAPAP inventory and 302 in the NECRMP inventory that were reviewed. About two thirds of these points were utility combustion units greater than 25 megawatts that were updated using the unit inventory. Data for the remaining points from both inventories were compared to determine which data should be included in the next generation of the NAPAP inventory.

Generally, the NECRMP data was judged to be of better quality than the original NAPAP data. For example, the NECRMP inventory had data representative of 1980 for Allegheny County in Pennsylvania, while the original NAPAP contained mostly 1970-1975 data. For several plants, however, the data contained in the original NAPAP was considered better than the NECRMP data. As an example, one organic chemical plant in Maryland had a process rate of 9,999,999 tons per year, resulting in 135,000 tons of emissions per year. NAPAP had a process rate of 100,000 tons per year and an emission rate of 3,390 tons of SO_2 per year. For a few other facilities, NECRMP contained industrial fuel use values that were 1,000 times larger than in NAPAP, and the NAPAP data was thought to be more accurate. For several

other plants, NAPAP contained 1980 data where NECRMP had 1978 or 1982 data. As a result of the QA comparison, 30 plants in NAPAP had data that appeared to be better than the NECRMP data.

Addition of Seasonal Factors for Area Sources

Seasonal allocation factors were developed and added to the NAPAP EIS/AS file for each of the 64 area source categories and for each county. These factors were derived mainly from Volume XVII of the NECRMP report and from Procedures for the Preparation of Emission Inventories for VOC, Volume II (Reference 9). The area source categories, the seasonal allocation factors, and the allocation level are shown in a table in Appendix F. State-specific factors were used where available with national averages used in other cases.

CHAPTER 4

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CHAPTER 5

FUTURE NAPAP EMISSION INVENTORY ACTIVITIES

Literally thousands of updates have been processed by ES to generate the current NAPAP inventory. The updates have resulted in a significant improvement over the original data base. It is recognized, however, that QA activities should continue in order to further improve the 1980 NAPAP data base. Current plans call for updates to be made on a continuing basis through the remainder of this year.

The 1980 NAPAP data base has been extended to provide the seasonal resolution required for Lagrangian modeling. Seasonal throughput percentages have been updated for electric utility combustion units with capacities of 25 megawatts or greater and seasonal factors have been developed for area sources and entered into the data base. Further resolution of the existing inventory will, however, be necessary to produce the emissions input necessary for Eulerian modeling. Future data base activities are briefly discussed in the paragraphs that follow.

IMPROVEMENTS FOR REMAINDER OF FISCAL YEAR 1984

Further improvements to the NAPAP data base are expected to originate from QA efforts by ES and others and visits to a number of state agencies to verify/update data for the largest sources. Although the QA efforts are yet to be completed, the following types of activities are anticipated:

- Incorporation of improved unit inventory data for power plants.
- Investigation of large facilities with years of record other than 1980.
- Resolution of discrepancies between NAPAP and NECRMP area sources.
- Collection of missing UTM and stack data for point sources with large SO_2 or NO_x emissions.
- Addition of latitude and longitude locations for point sources and area source county centroid coordinates.

It is expected that data base reviewers and users will identify other problems for investigation.

The state visits presently consist of examining data maintained by 18 of the state agencies. The 50 largest non-utility emitters of SO_2, NO_x, and VOC (100 tons per year cutoff) will be considered in each state. Data currently in NAPAP will be compared to data gathered during the visit and any updates necessary for key data fields will be made.

Emission inventory data to support development of Eulerian models has been requested to be available by October 1984. The preliminary model requires the development of grid-level (grids defined as 1/4 degree longitude by 1/6 degree latitude) emissions estimates, and temporal resolution to typical weekdays and weekend days for each season, each disaggregated into 24 one-hour segments. The area to be covered is the 48 contiguous states or the 15 states in the NECRMP domain at a minimum. Pollutants to be included are at a minimum SO_2, NO, NO_2, ten VOC species categories, primary sulfates, and ammonia. Also desired are emissions of CO, alkaline dust, graphitic and organic carbon, iron, manganese, HCl, and HF. A major portion of the remaining FY 84 resources will be devoted to trying to provide at least the minimum data needed for Eulerian modeling.

FISCAL YEAR 1985 AND FUTURE IMPROVEMENTS

It is anticipated that the bulk of the NAPAP emission inventory resources for FY 85 will be spent to support Eulerian modeling requirements. The funding level that is available for FY 85 will determine the extent to which refinements to the inventory can be completed. The addition of more pollutants, expansion of the geographic domain to include all 48 contiguous states and Canada, and additional temporal resolution of the data may be required.

Another activity planned for FY 85 is coordination with Task Group A for the inclusion of natural emissions into NAPAP. Of particular concern for Eulerian modeling activities would be estimates of biogenic emissions of ammonia, VOC, and sulfur.

A procedure for evaluating the uncertainty of the emissions data in NAPAP is being developed by Brookhaven National Laboratory. Assuming that adequate funds will be available to implement this procedure in FY 85, the results of the analysis should indicate areas of the NAPAP inventory that are in need of improvement. Follow-up quality assurance activities to address the areas of greatest uncertainty would then be appropriate.

Other activities that have been proposed for improvement of the NAPAP inventory contingent upon the availability of adequate funds are:

- Expanded quality assurance activities, including review and verification of NAPAP data by the states.
- Incorporation of continuous emission monitoring (CEM) data to improve the accuracy and temporal resolution of emissions data for the largest point sources.

- Additional source testing for development of emission factors, particularly for the additional pollutants required for Eulerian modeling that are not currently in NAPAP.

- Begin development of an updated NAPAP inventory for a year of record more recent than 1980. Originally, development of an inventory for base year 1984 was planned.

- To the extent possible, coordinate NAPAP emission inventory activities with other related work (such as emission inventory data being developed for EPRI).

REPORTING

ES has released versions of the NAPAP data base to all members of the user community who have requested it. Various summaries of the inventory have been generated based on user requests. Members of the user community have been informed of the fact that further updates are planned for the 1980 NAPAP inventory and that the inventory has not been peerreviewed and approved for release by EPA and Task Group B. Users have been asked to recognize the unofficial status and non-finalized form of the inventory when making use of the data supplied. Tabular summaries and graphical displays have been prepared for several meetings to identify the status of the inventory. This report documenting ES activities on the NAPAP data base has been developed. In the future, requests for NAPAP reports will be coordinated by the EPA National Air Data Branch (NADB) at Research Triangle Park, North Carolina. ES will continue to provide technical assistance in filling these requests, as necessary. When significant improvements have been made to the data base, revised documentation will be compiled for dissemination. Although data base modifications will be made on a continual basis, it will take about four to six months before the accumulated changes result in a significant improvement. At that time, a new version of the data base including documentation will be released. Significant changes from the previous version of the data base will be identified.

APPENDIX A

YEAR-OF-RECORD DISTRIBUTION IN THE NAPAP EMISSIONS INVENTORY

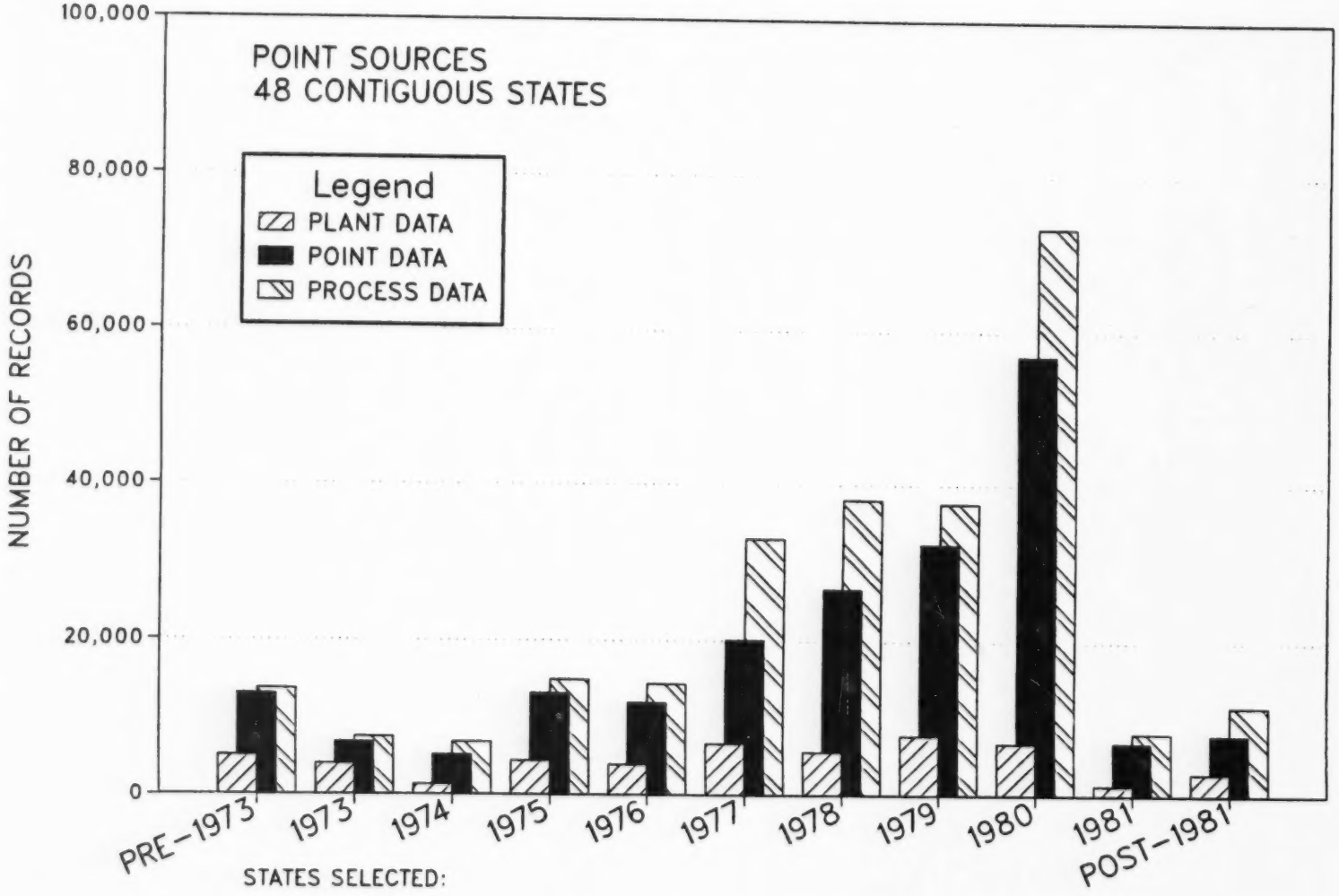

Figure A.1 Year-of-Record Distribution in the NAPAP Emissions Inventory (Preliminary Data)

APPENDIX B

FUEL USE COMPARISON

TABLE B.1

FUEL USE COMPARISON FOR ELECTRIC UTILITY SECTOR (PRELIMINARY DATA)

State	Anthracite Coal (10^3 tons)		Bituminous Coal and Lignite (10^3 tons)		Natural Gas (10^9 ft^3)		Distillate and Residual Fuel (10^3 barrels)	
	SEDR[a] (1980)	NAPAP[b]	SEDR[a] (1980)	NAPAP[b]	SEDR[a] (1980)	NAPAP[b]	SEDR[a] (1980)	NAPAP[b]
Alabama	0	0	19,593	19,617	1	1	131	49
Arizona	0	0	10,916	10,916	50	49	1,622	1,813
Arkansas	0	0	1,774	1,593	59	66	3,285	3,163
California	0	0	0	0	519	528	65,222	65,412
Colorado	0	0	10,121	10,121	32	37	444	550
Connecticut	0	0	0	45	--[c]	--[c]	21,596	23,728
Delaware	0	0	942	1,036	7	8	6,018	6,301
District of Columbia	0	0	0	0	0	0	1,572	1,573
Florida	0	0	8,785	8,336	166	169	73,194	75,500
Georgia	0	0	21,191	21,287	4	8	1,085	873
Idaho	0	0	0	0	--[c]	0	0	0
Illinois	0	0	34,611	36,482	19	20	13,608	14,016
Indiana	0	0	33,664	34,961	2	2	730	637
Iowa	0	0	10,745	13,188	7	7	231	356
Kansas	0	0	10,034	10,633	101	118	875	991
Kentucky	0	0	24,383	26,455	2	2	227	225
Louisiana	0	0	0	0	425	471	8,270	9,466
Maine	0	0	0	0	0	0	3,680	2,611
Maryland	0	0	5,908	5,908	5	3	9,250	9,634
Massachusetts	0	0	676	676	5	3	46,342	47,114
Michigan	0	0	22,150	22,749	26	26	10,400	10,504
Minnesota	0	0	12,610	15,646	8	6	529	463
Mississippi	0	0	3,072	3,055	95	90	5,149	5,177
Missouri	0	0	23,168	23,388	15	8	567	461
Montana	0	0	3,352	3,352	4	4	59	71
Nebraska	0	0	4,702	6,058	12	15	262	311
Nevada	0	0	4,064	4,064	28	27	2,453	2,553
New Hampshire	0	0	1,080	1,080	--[c]	--[c]	4,366	5,007
New Jersey	0	0	2,545	7,263	80	103	15,740	68,271
New Mexico	0	0	11,406	10,004	56	51	391	205
New York	0	0	6,446	6,278	124	126	64,647	66,925
North Carolina	0	0	23,920	23,758	2	1	561	405
North Dakota	0	0	11,618	15,207	--[c]	0	68	60
Ohio	0	0	48,537	50,434	5	5	2,248	2,497
Oklahoma	0	0	5,752	6,275	330	309	59	29
Oregon	0	0	485	485	--[c]	0	110	35
Pennsylvania	951	788	41,515	42,873	3	1	19,464	20,986
Rhode Island	0	0	0	0	2	3	1,662	1,804
South Carolina	0	0	7,927	7,927	5	4	2,647	2,601
South Dakota	0	0	2,683	2,836	--[c]	--[c]	67	63
Tennessee	0	0	21,679	21,679	1	0	406	323
Texas	0	0	45,351	45,351	1,430	1,598	1,786	1,924
Utah	0	0	4,895	5,336	5	8	126	184
Vermont	0	0	9	0	--[c]	--[c]	63	88
Virginia	0	0	5,560	5,621	2	2	15,379	16,195
Washington	0	0	4,950	4,963	1	1	232	240
West Virginia	0	0	28,499	28,603	--[c]	--[c]	683	358
Wisconsin	0	0	13,229	12,587	14	11	567	584
Wyoming	0	0	13,498	14,510	--[c]	--[c]	123	189
Total	951	788	568,045	592,636	3,652	3,891	408,196	472,525

[a] State Energy Data Report, 1960 through 1981, Energy Information Administration, Washington, D.C., June 1983.

[b] National Acid Precipitation Assessment Program, data representative of 1980.

[c] Represents small, non-zero value.

TABLE B.2

FUEL USE COMPARISON FOR INDUSTRIAL SECTOR (PRELIMINARY DATA)

State	Anthracite Coal (10^3 tons)		Bituminous Coal and Lignite (10^3 tons)		Natural Gas (10^9 ft^3)		Distillate and Residual Fuel (10^3 barrels)	
	SEDR[a] (1980)	NAPAP[b]	SEDR[a] (1980)	NAPAP[b]	SEDR[a] (1980)	NAPAP[b]	SEDR[a] (1980)	NAPAP[b]
Alabama	14	0	2,526	2,441	171	201	7,143	13,318
Arizona	0	0	658	655	38	60	3,724	2,445
Arkansas	0	0	364	362	126	139	4,982	3,151
California	0	0	1,471	1,393	486	1,019	28,130	55,820
Colorado	0	0	892	1,135	60	69	5,623	5,299
Connecticut	4	10	0	0	20	28	9,918	11,952
Delaware	1	4	198	198	13	31	2,424	3,310
District of Columbia	0	0	23	56	1	1	246	213
Florida	0	0	792	788	102	114	20,750	22,014
Georgia	0	202	764	808	155	169	9,354	10,724
Idaho	0	0	414	561	32	39	2,335	943
Illinois	19	3	3,594	3,330	349	434	20,440	21,186
Indiana	1	0	4,418	5,026	245	284	17,037	14,592
Iowa	10	0	1,457	1,450	115	127	4,971	1,581
Kansas	0	0	337	335	191	249	4,480	1,878
Kentucky	28	0	1,763	1,863	66	134	7,290	3,794
Louisiana	0	0	108	110	1,182	1,180	20,906	47,096
Maine	4	1	103	94	1	1	4,809	11,551
Maryland	3	9	738	773	54	137	5,966	6,339
Massachusetts	19	0	94	94	29	43	4,549	8,883
Michigan	9	0	3,802	7,564	249	273	8,017	10,022
Minnesota	0	0	1,040	1,176	101	98	7,526	3,096
Mississippi	0	58	54	54	79	120	5,699	5,357
Missouri	2	0	1,384	1,486	78	217	5,485	5,655
Montana	0	0	183	182	20	35	5,943	4,623
Nebraska	0	0	292	291	52	60	3,440	774
Nevada	1	0	137	136	7	8	652	362
New Hampshire	1	1	10	10	1	2	1,481	2,927
New Jersey	22	0	12	104	63	120	25,033	26,628
New Mexico	0	1	7	65	74	101	3,054	1,324
New York	110	9	2,621	3,182	114	87	24,154	29,940
North Carolina	0	0	1,378	1,868	86	95	12,599	20,360
North Dakota	0	0	591	588	2	6	2,775	1,176
Ohio	29	0	5,834	6,487	321	597	18,269	15,129
Oklahoma	0	27	426	532	246	301	4,407	1,946
Oregon	0	0	227	260	39	45	6,520	4,654
Pennsylvania	879	349	4,001	4,037	337	376	22,683	27,937
Rhode Island	1	0	3	3	5	5	1,069	1,173
South Carolina	5	0	1,819	2,262	92	95	6,120	8,946
South Dakota	0	0	128	127	5	6	1,735	241
Tennessee	16	0	2,548	2,866	123	185	5,697	5,529
Texas	1	0	2,295	2,560	2,163	2,356	36,279	32,156
Utah	0	0	489	442	51	60	4,606	3,840
Vermont	3	0	2	2	2	2	736	503
Virginia	3	3	2,973	3,181	55	74	8,776	12,181
Washington	0	0	352	284	64	69	10,888	7,845
West Virginia	3	0	2,110	2,726	59	73	5,043	5,198
Wisconsin	1	0	2,059	2,360	130	141	5,028	4,878
Wyoming	0	0	1,670	2,338	48	91	8,399	6,612
Total	1,189	677	59,161	68,645	8,102	10,157	437,190	497,101

[a] State Energy Data Report, 1960 through 1981, Energy Information Administration, Washington, D.C., June 1983. May include fuel used as feedstock. SEDR data were adjusted to exclude coke plants.

[b] National Acid Precipitation Assessment Program, data representative of 1980.

TABLE B.3

FUEL USE COMPARISON FOR COMMERCIAL SECTOR (PRELIMINARY DATA)

State	Anthracite Coal (10^3 tons)		Bituminous Coal and Lignite (10^3 tons)		Natural Gas (10^9 ft^3)		Distillate and Residual Fuel (10^3 barrels)	
	SEDR[a] (1980)	NAPAP[b]	SEDR[a] (1980)	NAPAP[b]	SEDR[a] (1980)	NAPAP[b]	SEDR[a] (1980)	NAPAP[b]
Alabama	7	21	141	121	29	29	644	1,744
Arizona	0	0	0	48	27	28	280	317
Arkansas	0	0	4	2	31	31	549	1,028
California	0	2	3	3	260	269	10,036	10,870
Colorado	0	0	67	74	67	67	342	294
Connecticut	2	8	1	1	20	23	4,076	7,915
Delaware	1	2	1	0	3	4	4,899	4,974
District of Columbia	0	0	73	149	13	4	684	1,648
Florida	0	0	7	10	30	39	3,402	2,872
Georgia	0	0	15	22	59	59	325	594
Idaho	0	0	76	76	6	7	705	733
Illinois	10	60	103	48	228	128	4,733	5,208
Indiana	0	2	148	493	70	71	4,416	4,864
Iowa	5	33	61	81	51	51	830	1,301
Kansas	0	0	3	4	59	60	360	637
Kentucky	15	72	174	117	39	45	2,651	3,428
Louisiana	0	0	3	4	40	40	13,865	18,878
Maine	2	10	8	21	1	1	2,522	2,190
Maryland	2	0	19	30	30	17	4,024	3,534
Massachusetts	10	49	27	41	53	53	12,364	12,481
Michigan	5	29	206	318	190	198	3,348	4,333
Minnesota	0	0	96	180	64	69	1,475	2,556
Mississippi	0	0	1	0	21	21	3,429	3,493
Missouri	1	0	55	187	76	77	1,555	2,355
Montana	0	0	9	6	14	14	353	487
Nebraska	0	0	13	17	43	43	204	851
Nevada	0	2	2	3	10	10	360	911
New Hampshire	0	0	0	0	4	5	1,416	1,462
New Jersey	12	21	0	0	60	51	20,117	22,064
New Mexico	0	0	30	42	25	24	133	789
New York	56	16	89	421	162	205	39,923	24,195
North Carolina	0	0	116	88	26	28	2,164	3,431
North Dakota	0	0	96	136	11	9	1,042	1,773
Ohio	15	50	369	925	166	167	2,971	3,576
Oklahoma	0	0	20	30	47	48	345	403
Oregon	0	0	11	13	15	15	2,668	2,764
Pennsylvania	453	670	280	289	118	110	7,379	5,787
Rhode Island	1	3	0	0	7	7	797	1,162
South Carolina	2	16	133	150	23	23	516	795
South Dakota	0	0	11	36	9	8	384	611
Tennessee	8	30	144	101	44	59	1,063	1,445
Texas	0	2	1	3	169	168	5,411	10,595
Utah	0	0	159	205	--[c]	2	2,079	2,119
Vermont	2	7	0	0	1	1	857	354
Virginia	2	1	128	126	38	42	2,077	5,142
Washington	0	0	108	4	31	31	1,499	4,275
West Virginia	1	9	87	17	22	22	267	388
Wisconsin	0	0	34	192	77	77	1,712	2,192
Wyoming	0	0	71	153	5	4	455	550
Total	612	1,115	3,203	4,987	2,594	2,564	177,706	194,015

[a] State Energy Data Report, 1960 through 1981, Energy Information Administration, Washington, D.C., June 1983.

[b] National Acid Precipitation Assessment Program, data representative of 1980.

[c] Represents small, non-zero value.

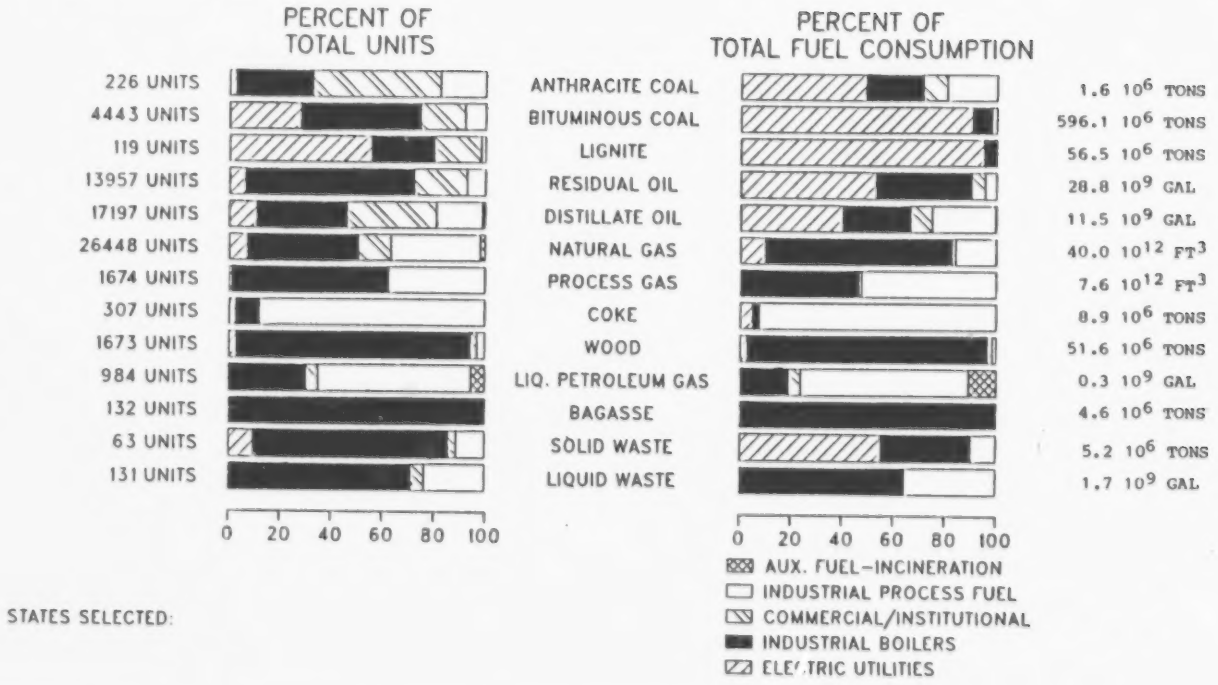

Figure B.1 Distribution of Fuel Consumption Among Five Use Categories (Preliminary Data)

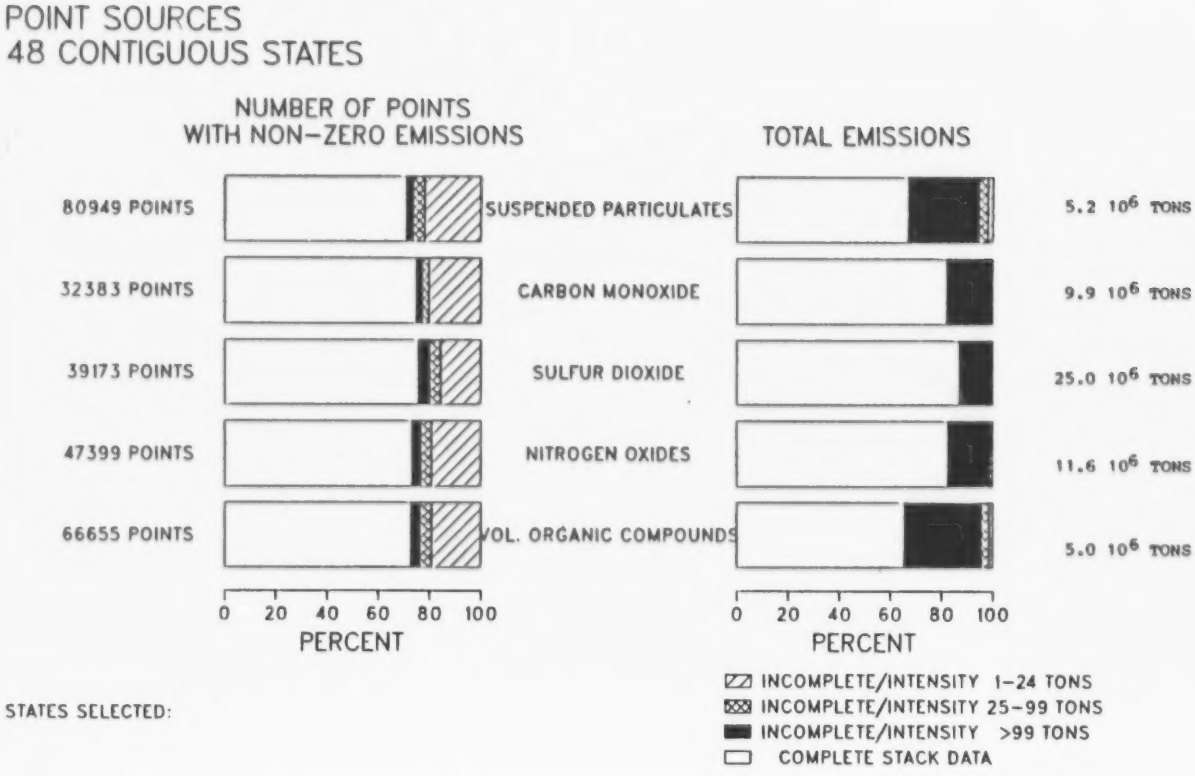

Figure C.1 Distribution of Points and Emissions with Complete/Incomplete Stack Data (Preliminary Data)

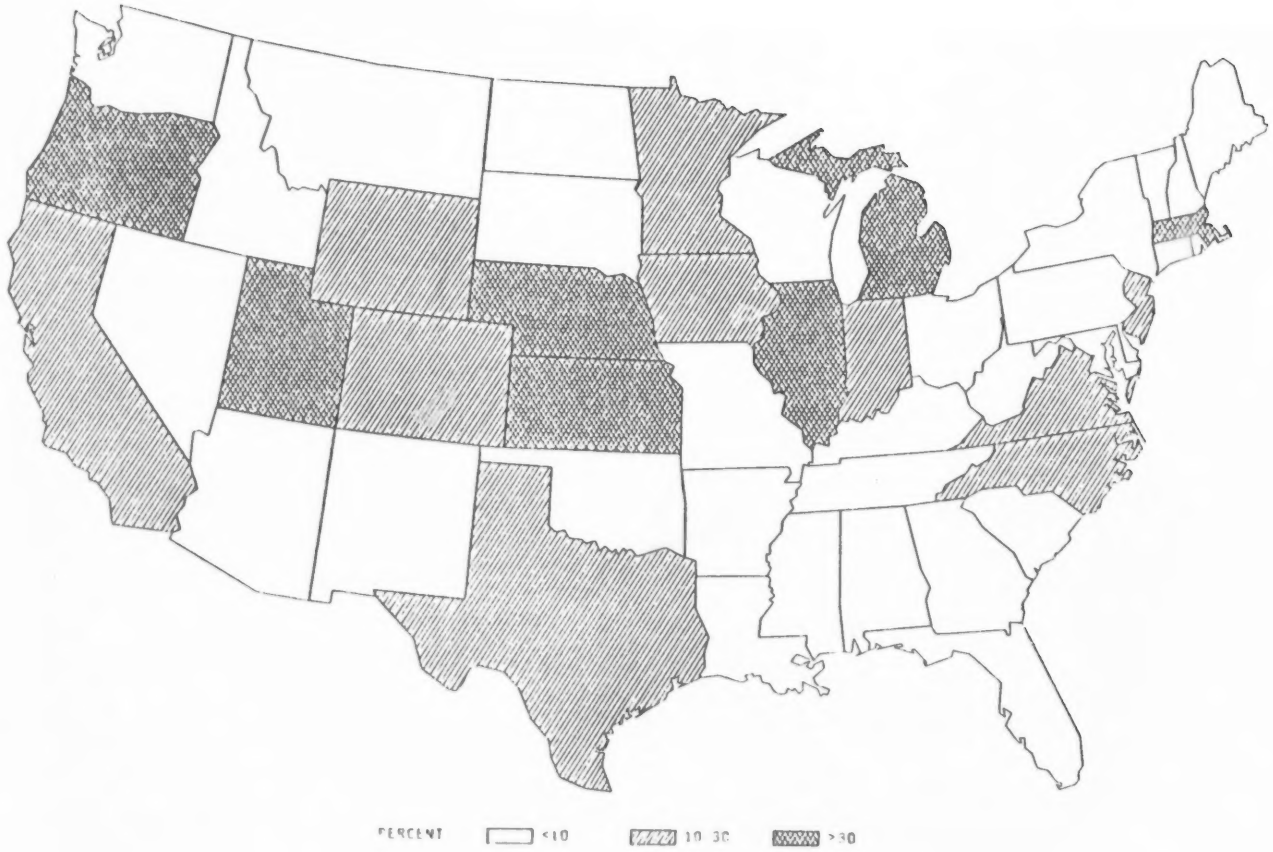

Figure C.2 Percent of SO_2 Emissions from 100-Ton Emitters with Incomplete Stack Data in the NAPAP Emissions Inventory (Preliminary Data)

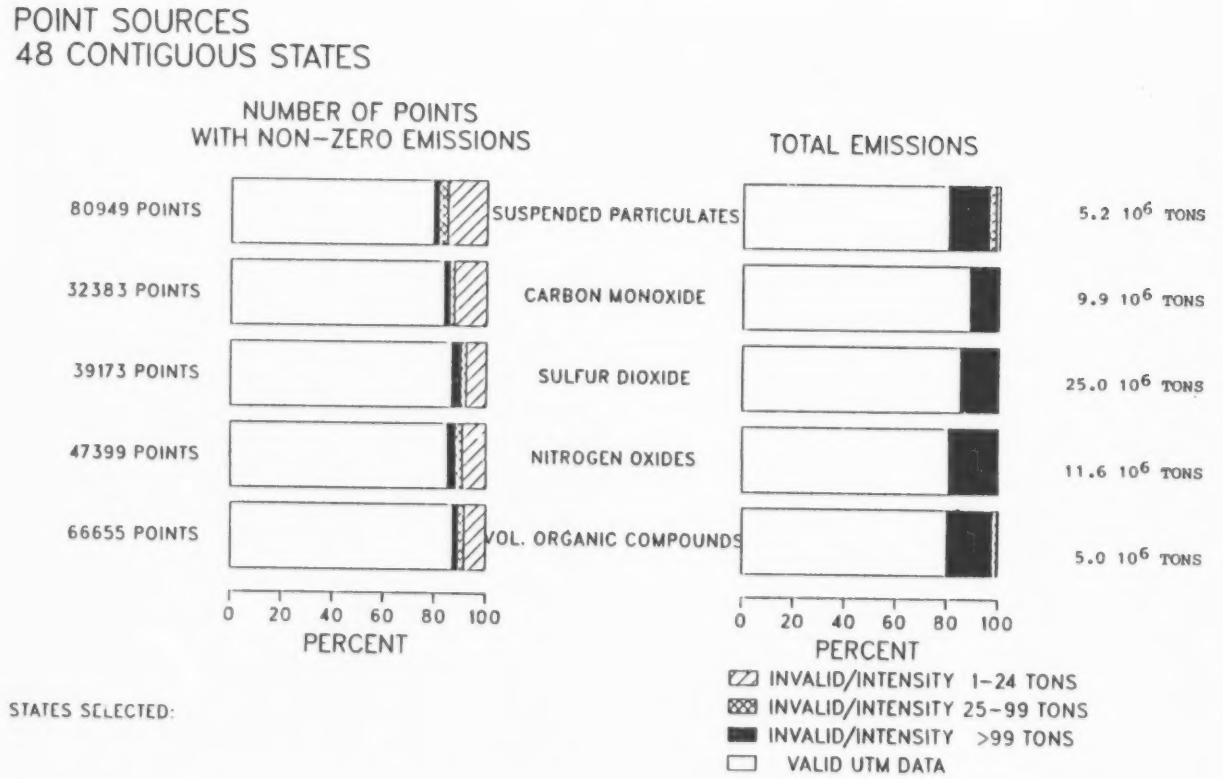

Figure D.1 Distribution of Points and Emissions with Valid/Invalid UTM Data (Preliminary Data)

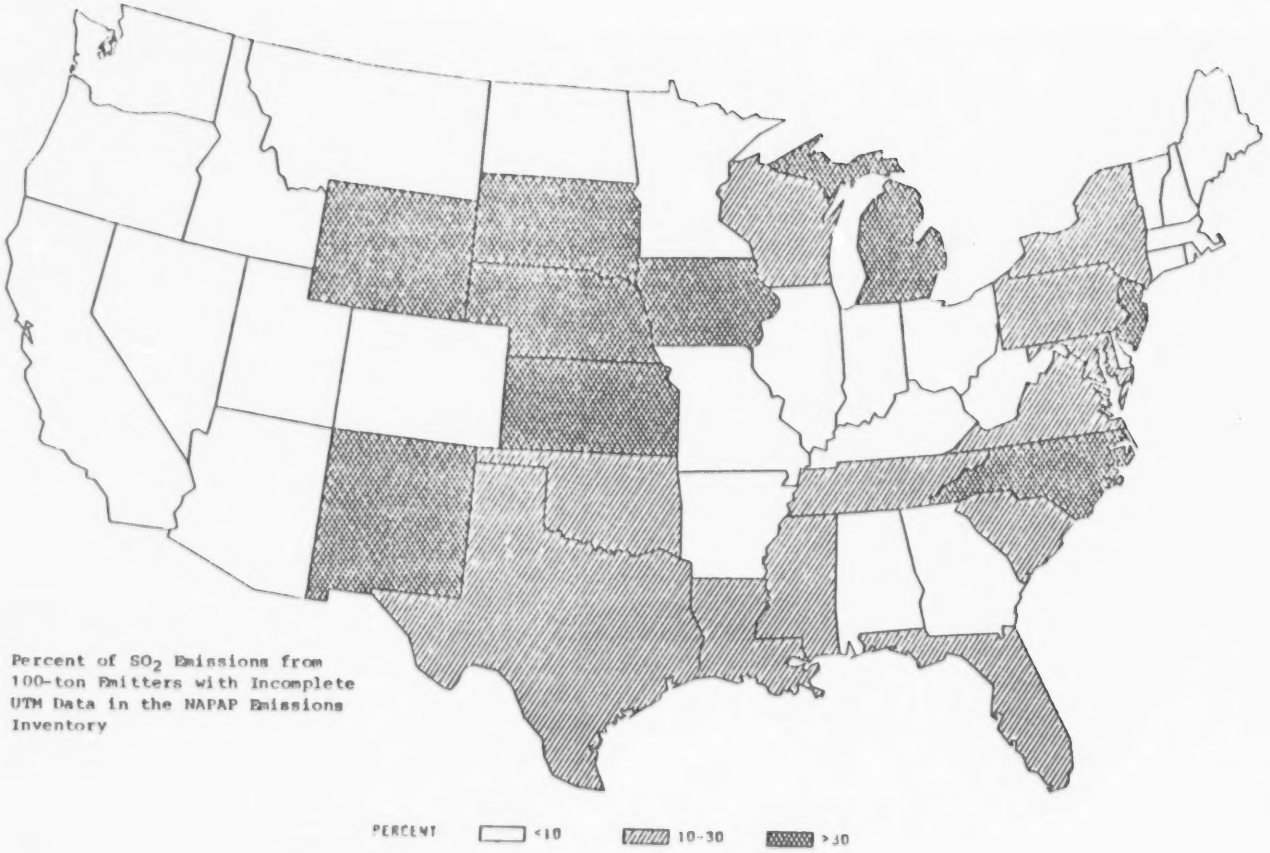

Figure D.2 QC Check for Location (Preliminary Data)

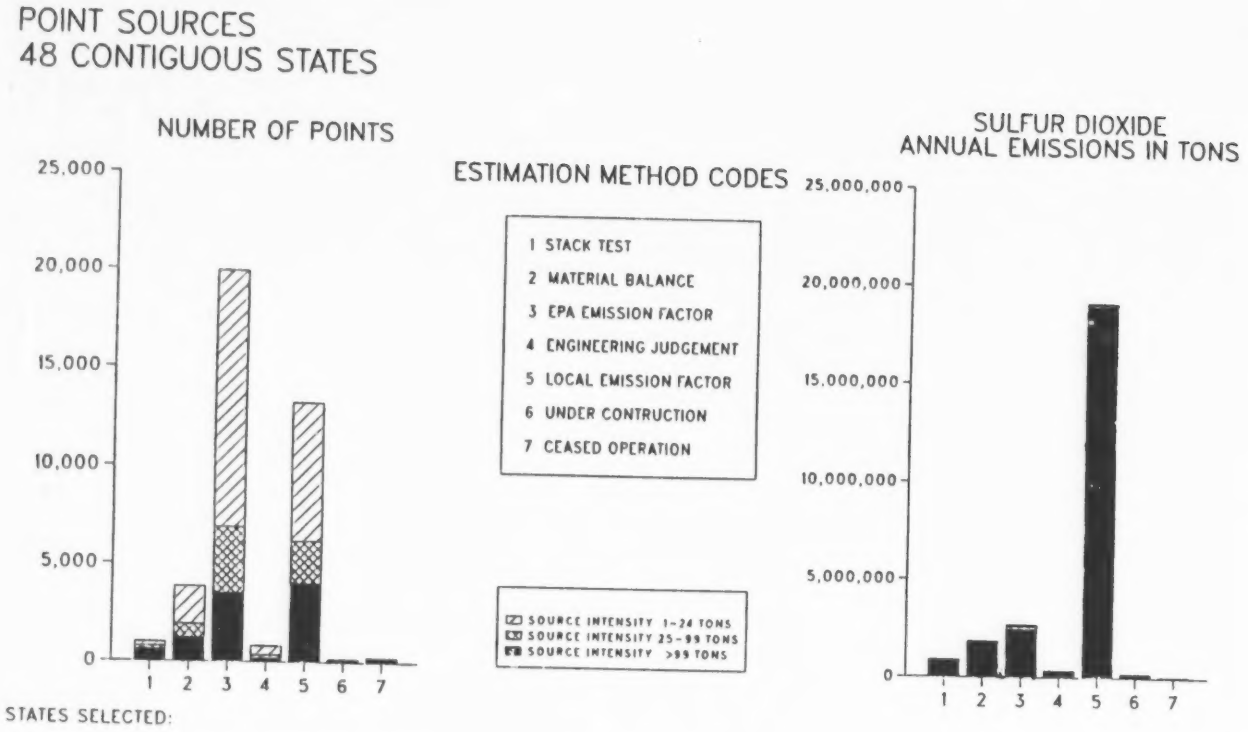

Figure E.1 Number of Points and Emissions with Respect to Emission Estimation Method (Preliminary Data)

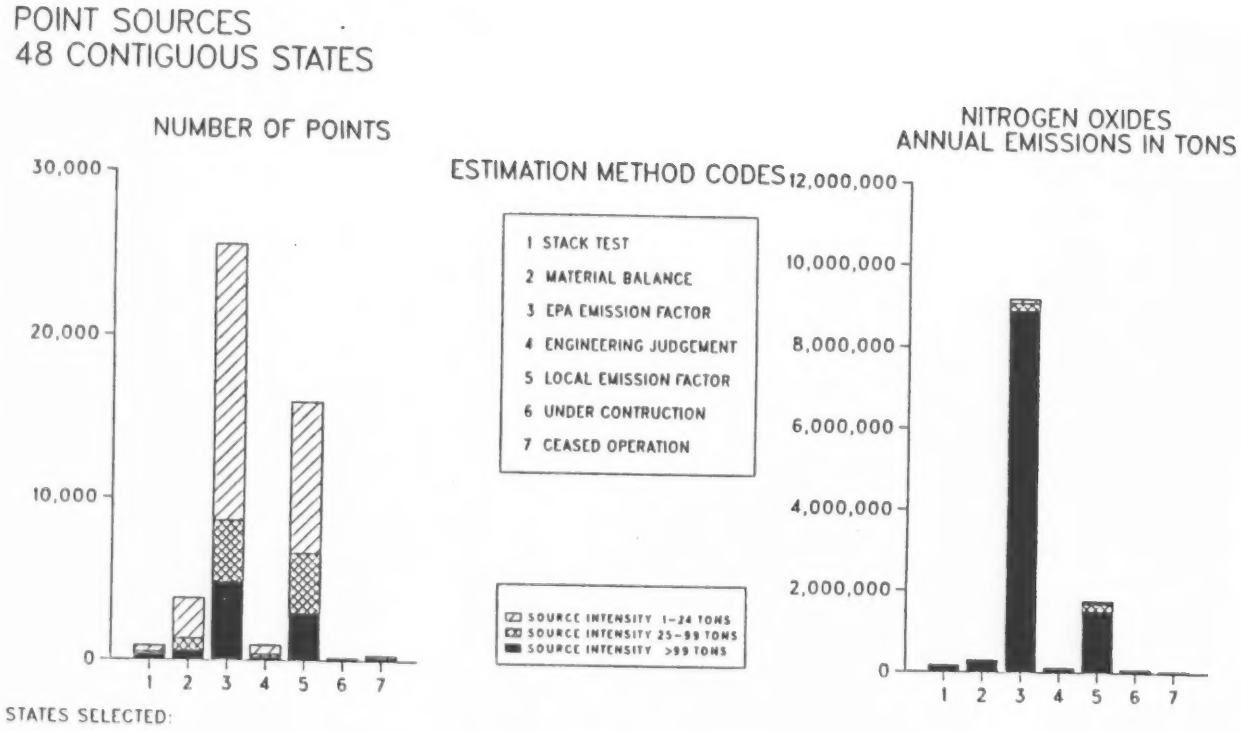

Figure E.2 Number of Points and Emissions with Respect to Emission Estimation Method (Preliminary Data)

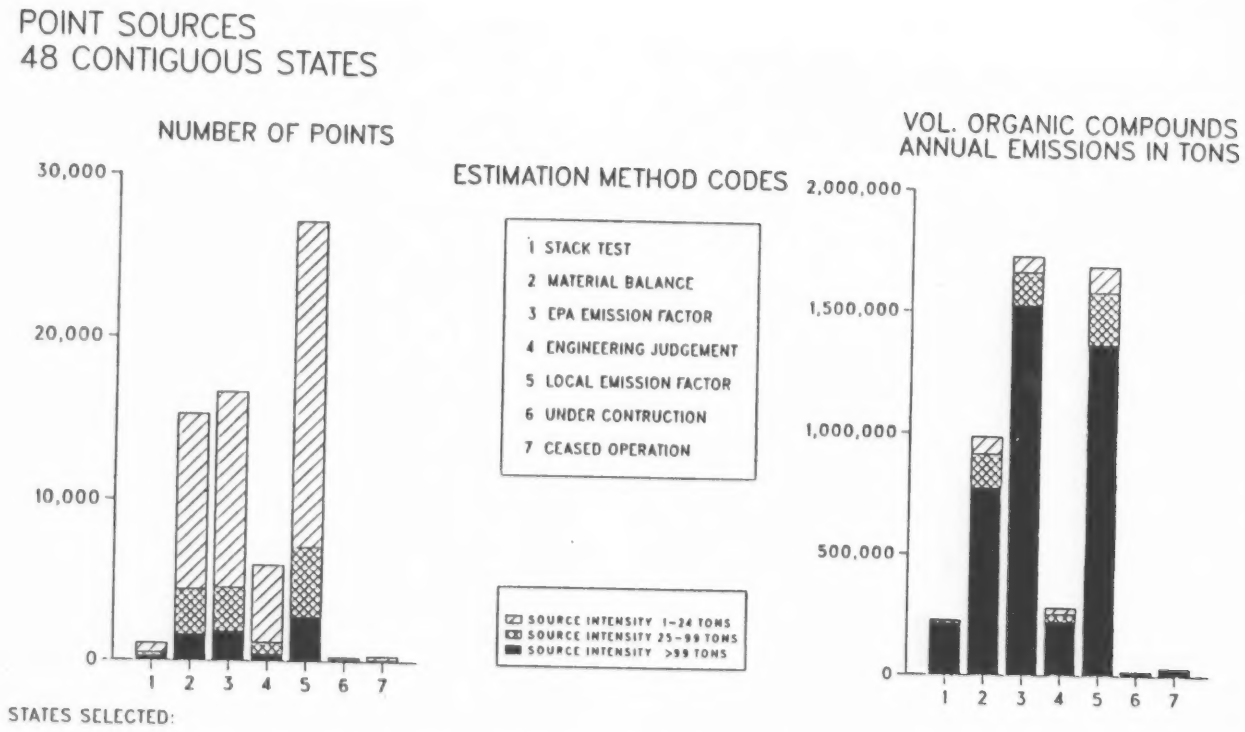

Figure E.3 Number of Points and Emissions with Respect to Emission Estimation Method (Preliminary Data)

APPENDIX F

AREA SOURCE SEASONAL ALLOCATION FACTORS FOR NAPAP

TABLE F.1

AREA SOURCE SEASONAL ALLOCATION FACTORS FOR NAPAP (PRELIMINARY DATA)

EIS/AS Category Number	Category Description	Allocation Factor	Allocation Level
01-06	Residential Fuel Use	Heating degree days for 1980 at representative state site	State
07-12	Comm./Inst. Fuel Use	25% uniform thru year, 75% uniform for months with $\bar{T}$ <68°F 1980 data	State
13-20	Industrial Fuel Use	Uniform	National
21-23	On-site Incineration	Uniform	National
24-26	Open Burning	Uniform	National
27-30	LDV Gasoline	Highway use of gasoline by months-1980 (Highway Statistics)	State
31-34	MDV Gasoline	Highway use of gasoline by months-1980 (Highway Statistics)	State
35-38	HDV Gasoline	Highway use of gasoline by months-1980 (Highway Statistics)	State
39	Off-Highway Gasoline	National average (W-20, SP-25, SU-30, A-25)	National
40-43	HDV Diesel	Private and commercial use of special fuels-1980 (Highway Statistics)	State
44	Off-Highway Diesel	National average (W-20, SP-25, SU-30, A-25)	National
45	Locomotives	Uniform	National
46	Military LTO's	Uniform	National
47	Civil LTO's	Uniform	National
48	Commercial LTO's	National average (W-25, SP-23, SU-26, A-26)	National
49	Coal Vessels	Uniform	National
50	Diesel Oil Vessels	Uniform	National
51	Residual Oil Vessels	Uniform	National
52	Gasoline Vessels	Uniform during months which have $\bar{T}$ >45°F	State
53	Solvent Purchased	Uniform	National
54	Gasoline Marketed	Highway use of gasoline by months-1980	State
55	Unpaved Roads	W-0% in snowbelt; seasonal 0.01 inch precipitation data	State
56	Unpaved Air Strip	W-0% in snowbelt; seasonal 0.01 inch precipitation data	State
57	Construction	National average (W-20, SP-25, SU-30, A-25)	National
58	Wind Erosion	Uniform	National
59	Land Tilling	Uniform	National
60	Forest Wild Fires	Assume 5/5/50/40 (NECRMP)	National
61	Managed Burning	Assume 10/70/0/20 (NECRMP)	National
62	Agricultural Burning	(W-0, SP-50, SU-0, A-50) except states 10 and 19	National
63	Frost Control	(W-0, SP-50, SU-0, A-50)	National
64	Structural Fires	Uniform	National

NOTE: A "uniform" allocation factor assumes a constant level of emissions throughout the year. This is essentially a "default" allocation for categories in which it is assumed that seasonal variations would be minimal.